

# INSECTS OF HAWAII

*A Manual of the Insects of the Hawaiian Islands, including an Enumeration of the Species and Notes on their Origin, Distribution, Hosts, Parasites, etc.*

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## VOLUME 7 MACROLEPIDOPTERA

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made possible the completion and publication of this volume.*



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## PREFACE TO VOLUME 7

This seventh volume of *Insects of Hawaii* contains information concerning 168 kinds of larger moths and butterflies (Macrolepidoptera) known to me to occur in Hawaii when my records were closed at the end of 1956. These insects are contained in 46 genera. Fifty-nine of the moths belong to the Geometridae, 90 to the Noctuidae and nine to the Sphingidae. There are 10 butterflies. Of the total of 158 moths, 130 are endemic and 28 foreign. Twelve genera and subgenera are endemic. Only two of the 10 species of butterflies are endemic. The fact that, in all of the large, mountainous, densely forested, tropical Hawaiian Islands, there are only two native butterflies will astonish most readers. Excluding these two butterflies, only three families of Macrolepidoptera—the Geometridae, Noctuidae and Sphingidae—are represented in Hawaii. These facts emphasize the isolation of the Hawaiian Archipelago.

Entomologists in Hawaii will note herein many changes in the names which they have been accustomed to use. During the course of this research, it has been discovered that nearly 60 percent of the names of the Hawaiian Macrolepidoptera, as used in Hawaii, required change.

I have now listed about 1,370 kinds of insects in these first seven volumes of *Insects of Hawaii*. Over 4,000 species remain to be included. Volume 8, *Lepidoptera: Pyraloidea*, is in press and is scheduled to appear soon after this seventh volume. The previously published volumes in this series are: 1—*Introduction* (Geology, Evolution, Distribution, etc.); 2—*Apterygota to Thysanoptera*; 3—*Heteroptera*; 4—*Homoptera: Auchenorrhyncha*; 5—*Homoptera: Sternorrhyncha*; 6—*Ephemeroptera-Neuroptera-Trichoptera and Supplement to Volumes 1 to 5*. There remain to be completed volumes on the Microlepidoptera, Coleoptera, Hymenoptera and Diptera. I am now working on the Microlepidoptera, and over a period of more than 20 years, I have assembled extensive manuscripts on the Coleoptera and Hymenoptera. Several years ago, I invited D. Elmo Hardy, entomologist, Hawaii Agricultural Experiment Station, University of Hawaii, to undertake the task of preparing the volumes on the Diptera, and two of his volumes are expected to be published soon.

The "Preface to the First Five Volumes," in Volume 1 of this series, contains a detailed outline of the plan and scope of the series, as well as comments and general acknowledgements.

The major purpose of these volumes is to take stock of the known Hawaiian insects and to facilitate their identification. It has never been my intention to describe new species in these books, although I have examined large numbers of new species during the course of the writing. Had I described the new species I know, few volumes could ever have been completed, and I might still be working on only the second or third systematic volume of this series. These books have been written to be used with *Fauna Hawaiiensis* and the *Proceedings of the Hawaiian*

*Entomological Society*, and it is assumed that readers will have available those publications.

Work began on this series soon after my return to the Bishop Museum, Honolulu, from the 1934 Mangarevan Expedition to southeastern Polynesia. I was then greatly encouraged, stimulated and aided by my gentle and faithful mentor, the late C. Montague Cooke, Jr. The task was continued during my years at the Bishop Museum and later at the Experiment Station, Hawaiian Sugar Planters' Association, until I resigned in 1954, following administrative changes which resulted in abandonment of work on this series. During my service with the Experiment Station, C. E. Pemberton was my superior officer, and he always gave me his strongest support and contributed much toward the progress of my work. In 1949, a Fulbright grant, together with further support from the Trustees of the Hawaiian Sugar Planters' Association, enabled me to spend two years at the British Museum (Natural History). The work has been supported by the National Science Foundation since 1954, and the research was continued at the British Museum (Natural History) through 1956.

I am most deeply indebted to the National Science Foundation, Washington, for their generous support and for their broad understanding of the many problems involved in this project. The Foundation's aid came to the rescue of Volumes 6, 7 and 8 and made possible their completion and publication. Had it not been for the Foundation, *Insects of Hawaii* would have died in 1954.

From the time of my arrival in Hawaii in 1934, Dr. O. H. Swezey, Experiment Station, Hawaiian Sugar Planters' Association, retired, has been a close friend, teacher, honored associate and a constant contributor to the progress of this series. Much of what I have recorded herein regarding the habits and early stages of the Hawaiian Lepidoptera has come from the researches of Dr. Swezey. This book would be a mere shadow of itself if it were not for the observations made by him over a period of nearly 50 years. No other person or combination of persons has contributed so much to our knowledge of the biologies of the Lepidoptera of Hawaii. I have more to say about Dr. Swezey in the section on the history of Hawaiian lepidopterology, page 28, below. My debt to him is very great, and I hope that the publication of these books will repay him, in small part, for some of his investment in me.

This book could never have been completed without the cooperation of the Trustees, Director Sir Gavin de Beer, and the able staff of the British Museum (Natural History). To them I am most deeply indebted. In my field of research, the collections and libraries of the Natural History Museum are the most complete and best organized in the world. It is there, of course, that the incomparably great Hawaiian historical collections of Dr. R. C. L. Perkins are stored.

The California Academy of Sciences, San Francisco, which I have known for more than 30 years, and its director, Robert C. Miller, have kindly administered the National Science Foundation grant, and E. S. Ross and Hugh B. Leech, officers in charge of entomology at the Academy, have aided me in many ways.

Juliette Wentworth, although retired and now living on the rim of Kilauea volcano with her geologist husband, has edited this volume as she so ably edited the

previous six volumes. Thomas Nickerson, chairman, University of Hawaii Press, and his entire staff deserve the best of thanks for the efficient manner in which they have carried this volume through the processes of publication, and I extend my special thanks to Aldyth V. Morris, managing editor, who has had direct charge of the production of this book.

This text could never have been completed in its present form were it not for the unparalleled assistance received from W. H. T. Tams, D. S. Fletcher and J. D. Bradley. Mr. Tams's knowledge of facts and literature pertaining to the Lepidoptera is a well-known phenomenon, and the flow of information from him to me has for years been voluminous. His willingness to help others—at the sacrifice of his own studies—characterizes him as a person of extraordinary generosity, and I owe him much, as do many entomologists the world over. D. S. Fletcher, specialist on the Geometridae, made most of the dissections of that family used for this book. Also, he made many dissections of Noctuidae and other groups, and he has assisted me cheerfully in many ways too numerous to mention. J. D. Bradley, expert on the Microlepidoptera, has been a constant source of assistance since I first went to the British Museum in 1949, and I shall speak more of him in later volumes. N. H. Bennett and T. G. Howarth assisted generously with the section on the butterflies, and C. L. Collenette, H. M. Edelsten and Edward L. Martin contributed valuable information and assistance. These men, with the present exception of Mr. Martin, who has transferred to the Geology Museum, are staff members of the British Museum (Natural History).

Other British Museum staff members who have assisted in the production of this book include N. D. Riley, (retired Keeper of Entomology), W. E. China, (Keeper of Entomology), J. P. Doncaster, J. Balfour-Browne, E. B. Britton, J. F. Perkins (son of Dr. R. C. L. Perkins), Miss C. M. F. von Hayek, B. J. Clifton, A. C. Townsend, C. W. F. Claxton, Miss B. Eborall, S. F. Turpin and M. E. Bacchus.

Pierre Viette, Museum National d'Histoire Naturelle, Paris, ably assisted in the preparation of dissections in 1949, but most of his work was devoted to the Pyraloidea and will be acknowledged further in Volume 8.

Mrs. D. J. Williams and Mrs. J. P. Doncaster typed the final draft of the manuscript, and their husbands, mentioned above and below, assisted greatly in proofreading the typescript.

L. D. Tuthill was responsible for originally introducing this series to the University of Hawaii Press and for recommending its publication, and his interest and assistance continue undiminished.

At the Experiment Station, Hawaiian Sugar Planters' Association, my former associates, now retired, C. E. Pemberton, F. X. Williams and R. H. Van Zwaluwenburg, contributed much to this work over the years. Dr. Pemberton remains a constant contributor of assistance of many kinds. F. A. Bianchi and J. W. Beardsley have made special contributions to this volume by supplying specimens for study, and they have obtained a number of photographs, several of critical subjects required just before going to press.

In 1941, I spent several weeks working on preliminary manuscript at the U.S. National Museum. From that time until the present, J. F. Gates Clarke, now

Curator of Insects, has assisted me in ways too numerous to list here, and he has been a staunch supporter of this series. His associate, W. D. Field also has helped me.

Other workers who have played an active part in my work include:

Sir Guy A. K. Marshall, W. J. Hall, E. O. Pearson, Fritz van Emden, R. D. Pope, D. J. Williams, J. A. McDonald and R. J. Collins of the Commonwealth Institute of Entomology.

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O. W. Richards, Imperial College of Science, University of London. Professor Richards is always a source of valuable information and expert guidance, and it is stimulating to associate with him. It was under his direction that I earned my doctorate.

Francis Hemming, secretary, International Commission on Zoological Nomenclature, London, has answered questions concerning nomenclature and bibliography.

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Miss E. Evans, Royal Entomological Society of London, and her staff.

C. F. W. Muesebeck, Paul W. Oman and H. W. Capps, Department of Agriculture, Washington, have supplied much information.

Ernst Mayr, P. J. Darlington and W. L. Brown, Jr., Museum of Comparative Zoology, Harvard University. I spent much time in 1941 and again in 1956-58 enjoying the facilities at Harvard, and these men have contributed stimulating support and assistance.

Harold J. Coolidge, Pacific Science Board, National Research Council, Washington, has been an active supporter of this series.

J. G. Franclemont, now at Cornell University, assisted with some problems concerning the Noctuidae.

E. O. Essig, E. Gorton Linsley, R. L. Usinger and W. Harry Lange, Jr., University of California.

E. H. Bryan, Jr., and J. L. Gressitt, Bishop Museum, Honolulu, have sent specimens on loan and answered many questions.

I now come to the most pleasant duty of expressing my deepest appreciation to the artists and photographers whose excellent work enriches and embellishes the following pages. Instead of wasting tens of thousands of words on descriptive text, which all too often might be misleading, I present here a vast amount of critical information in the international language of illustration, and this, I am confident, my readers will appreciate.

Miss Hazel Rough made most of the drawings of the wings but, sadly, died before she completed the series.

Arthur Smith, British Museum (Natural History), completed the drawings of the wings, and he has done all of the heads, the diagrams of morphological features and other drawings.

J. T. Yamamoto, Experiment Station of the Hawaiian Sugar Planters' Association, photographed the types which are stored in Honolulu and many of the specimens illustrated here which are not types. He also contributed photographs of larvae and habit.

R. C. Pittman, Wallace Heaton, Ltd. (London), made most of the photographs of the British Museum types (whole specimens).

M. G. Sawyers and C. A. Horton, staff photographers, British Museum (Natural History), made many photographs of moths and dissections.

To Harold Malies, expert on photomicrography, formerly doing his work at the British Museum (Natural History), fell the huge and exacting task of making hundreds of photographs of the dissections, and his contribution to this volume is outstanding.

To the staff of the Advertiser Publishing Co., Ltd., Honolulu, I owe thanks for the care taken in the production of this book and for the expeditiousness of its manufacture.

E.C.Z.

*British Museum (Natural History)*

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**INSECTS OF HAWAII**



## CHECKLIST OF THE INSECTS IN THIS VOLUME

### Order **LEPIDOPTERA**

#### Suborder DITRYSIA

#### Series HETEROCERA

#### Superfamily GEOMETROIDEA

#### Family GEOMETRIDAE

#### Subfamily ENNOMINAE

Genus **ANACAMPTODES** McDunnough  
**fragilaria** (Grossbeck)

Genus **SCOTORYTHRA** Butler  
**anagraptis** Meyrick  
**apicalis** Swezey  
**arboricolans** Butler  
**artemidora** Meyrick  
**brunnea** (Warren)  
**capnopa** Meyrick  
**caryopis** Meyrick  
**corticea** (Butler)  
**crocorrhoa** Meyrick  
**demetrius** Meyrick  
**diceraunia** Meyrick  
**dissotis** Meyrick  
**epicyma** Meyrick  
**epixantha** (Perkins)  
**euryphaea** Meyrick  
**gomphias** (Meyrick)  
**goniastis** Meyrick  
**hecataea** Meyrick  
**hyparcha** Meyrick  
**kuschei** Swezey  
**leptias** Meyrick  
**macrosoma** Meyrick  
**metacrossa** Meyrick

**nephelosticta nephelosticta** Meyrick  
**nephelosticta cocyti**as Meyrick  
**ochetias** (Meyrick)  
**ortharcha** Meyrick  
**oxyphractis** Meyrick  
**pachyspila** Meyrick  
**paludicola** (Butler)  
**paratactis** Meyrick  
**platycapna** Meyrick  
**rara** (Butler)  
**trachyopis** Meyrick  
**trapezias** Meyrick  
**triscia** Meyrick

Subgenus **ACRODREPANIS** Perkins  
     **megalophylla** (Meyrick)  
     **nesiotes** (Perkins)

Genus **TRITOCLEIS** Meyrick  
     **microphylla** Meyrick

#### Subfamily LARENTIINAE

Genus **EUPITHECIA** Curtis  
     **craterias craterias** (Meyrick)  
     **craterias ditrecta** (Meyrick)  
     **dryinombra** (Meyrick)  
     **monticolans** Butler  
     **niphoreas** (Meyrick)  
     **orichloris** (Meyrick)  
     **phaeocausta** (Meyrick)  
     **prasinombra** (Meyrick)  
     **rhodopyra** (Meyrick)  
     **scoriodes** (Meyrick)  
     **staurophragma** (Meyrick)  
     **stypheliae** (Swezey)

Genus **FLETCHERANA** Zimmerman  
     **giffardi** (Swezey)  
     **insularis** (Butler)  
     **ioxantha** (Meyrick)  
     **leucoxyia** (Meyrick)  
     **roseata** (Swezey)

Genus **PROGONOSTOLA** Meyrick  
     Subgenus **PROGONOSTOLA** Meyrick  
         **cremnopis** Meyrick

Subgenus **ZIELA** Zimmerman  
**caustoscia** (Meyrick)

Genus **MEGALOTICA** Zimmerman  
 Subgenus **MEGALOTICA** Zimmerman  
**holombra** (Meyrick)  
 Subgenus **GELA** Zimmerman  
**aphoristis** (Meyrick)

## Superfamily NOCTUOIDEA

### Family NOCTUIDAE

#### Subfamily NOCTUINAE

Genus **HELIOTHIS** (Huebner) Ochseneheimer  
**hawaiiensis** (Quaintance and Brues)  
**virescens** (Fabricius)  
**zea** (Boddie)

Genus **AGROTIS** (Huebner) Ochseneheimer  
**arenivolans** Butler  
**aulacias** Meyrick  
**baliopa** Meyrick  
**bryani** (Swezey)  
**ceramophaea** Meyrick  
**charmocrita** (Meyrick)  
**cremata** (Butler)  
**crinigera** (Butler)  
**dislocata** (Walker)  
**epicremna** Meyrick  
**evanescens** (Rothschild)  
**fasciata** (Rothschild)  
**giffardi** (Swezey)  
**hephaestaea** Meyrick  
**ipsilon** (Hufnagel)  
**kerri** (Swezey)  
**laysanensis** (Rothschild)  
**melanoneura** Meyrick  
**mesotoxa** Meyrick  
**microreas** Meyrick  
**panoplias** Meyrick  
**perigramma** Meyrick  
**photophila** (Butler)  
**procellaris** Meyrick

**psammophaea** Meyrick  
**tephrias** Meyrick  
**xiphias** Meyrick

Genus **PERIDROMA** Huebner  
**albiorbis** (Warren)  
**chersotoides** (Butler)  
**cinctipennis cinctipennis** (Butler)  
**cinctipennis albistigma** (Warren)  
**coniotis coniotis** (Hampson)  
**coniotis rufata** (Warren)  
**neurogramma** (Meyrick)  
**porphyrea** (Denis and Schiffermueller)  
**selenias** (Meyrick)

Subfamily HADENINAE

Genus **TRICHOCLEA** Grote  
**postica** Smith

Genus **PSEUDALETIA** Franclemont  
**amblycasis** (Meyrick)  
**dasuta** (Hampson)  
**macrosaris** (Meyrick)  
**unipuncta** (Haworth)

Genus **HALIOPHYLE** Warren  
**anthracias** (Meyrick)  
**compsias** (Meyrick)  
**connexa** (Warren)  
**euclidias** (Meyrick)  
**ferruginea** (Swezey)  
**flavistigma** (Warren)  
**ignita** (Warren)  
**niphadopa** (Meyrick)

Subfamily APAMEINAE

Genus **ACRAPEX** Hampson  
**exanimis** (Meyrick)

Genus **ELAPHRIA** Huebner  
**nucicolora** (Guenée)

Genus **ELYDNA** Walker  
**nonagrica** (Walker)

Genus **SPODOPTERA** Guenée  
**exempta** (Walker)  
**exigua** (Huebner)  
**mauritiae acronyctoides** (Guenée)

## Subfamily STICTOPTERINAE

Genus **STICTOPTERA** Guenée  
**subobliqua** (Walker)

## Subfamily ERASTRINAE

Genus **AMYNA** Guenée  
**natalis** (Walker)

Genus **BOCANA** Walker  
**manifestalis** Walker

## Subfamily CATOCALINAE

Genus **ACHAEA** Huebner  
**janata** (Linnaeus)

## Subfamily PLUSIINAE

Genus **PLUSIA** Huebner  
Subgenus **LOPHOPLUSIA** Zimmerman  
**giffardi** (Swezey)  
**psectrocera** (Hampson)  
**pterylota** (Meyrick)  
**violacea** (Swezey)

Subgenus **TRICHOPLUSIA** (McDunnough)  
**ni brassicae** (Riley)

Subgenus **AUTOGRAPHIA** (Huebner)  
**biloba** (Stephens)  
**chalcites** (Esper)

## Subfamily HYPOCALINAE

Genus **OTOSEMA** Huebner  
**odora** (Linnaeus)

Genus **GONITIS** Guenée  
**vulpicolor** (Meyrick)

Genus **ANOMIS** Huebner  
    **hawaiiensis** (Butler)  
    **noctivolans** (Butler)

Genus **HYPOCALA** Guenée  
    **deflorata** (Fabricius)  
    **velans** Walker

Genus **POLYDESMA** Boisduval  
    **umbricola** Boisduval

Genus **SIMPLICIA** Guenée  
    **lautokiensis** Prout

#### Subfamily HYPENINAE

Genus **HYPENA** Schrank  
    **laysanensis** (Swezey)  
    **newelli** (Swezey)  
    **obsoleta** (Butler)  
    **plagiota** (Meyrick)  
    **senicula** (Meyrick)

Genus **SCHRANKIA** Huebner  
    **altivolans** (Butler)  
    **arrhecta** (Meyrick)  
    **oxygramma** (Meyrick)  
    **sarothrura** (Meyrick)  
    **simplex** (Butler)

Genus **PSEUDOSCHRANKIA** Zimmerman  
    **cyanias** (Meyrick)  
    **epichalca** (Meyrick)  
    **leptoxantha** (Meyrick)

#### Superfamily SPHINGOIDEA

##### Family SPHINGIDAE

##### Subfamily PHILAMPELINAE

##### Tribe PHILAMPELINI

Genus **TINOSTOMA** Rothschild and Jordan  
    **smaragditis** (Meyrick)

## Subfamily CHAEROCAMPINAE

Genus **CELERIO** Oken**calida calida** (Butler)**calida hawaiiensis** Rothschild and Jordan**lineata lineata** (Fabricius)**wilsoni wilsoni** (Rothschild)**wilsoni perkinsi** (Swezey)

## Subfamily SPHINGINAE

Genus **HERSE** Oken**cingulata** (Fabricius)Genus **PHLEGETHONTIUS** Huebner**quinguemaculatus blackburni** (Butler)**quinguemaculatus quinguemaculatus** (Haworth)

## Series RHOPALOCERA

## Superfamily PAPILIONOIDEA

## Family PIERIDAE

Genus **PIERIS** Schrank**rapae** (Linnaeus)

## Family NYMPHALIDAE

## Subfamily NYMPHALINAE

Genus **VANESSA** Fabricius**atalanta** (Linnaeus)**cardui** (Linnaeus)**tameamea** Eschscholtz**virginiensis** (Drury)

## Family DANAIIDAE

Genus **DANAUS** (Linnaeus) Kluk**plexippus** (Linnaeus)

## Family LYCAENIDAE

## Subfamily THECLINAE

Genus **STRYMON** Huebner**bazochii gundlachianus** (Bates)**echion** (Linnaeus)

## Subfamily LYCAENINAE

Genus **LAMPIDES** Huebner**boeticus** (Linnaeus)Genus **VAGA** Zimmernian**blackburni** (Tuely)



## SUMMARY OF THE NOMENCLATORIAL CHANGES MADE IN THIS VOLUME

### GEOMETRIDAE

- Sisyrophyta* Meyrick, 1899, is a new synonym of *Scotorythra* Butler, 1883.  
*Nesoclide* Perkins, 1901, is a new synonym of *Scotorythra* Butler, 1883.  
*Scotorythra syngonopa* Meyrick, 1899, is a new synonym of *Scotorythra arboricolans* Butler, 1883.  
*Scotorythra homotrias* Meyrick, 1899, is a new synonym of *Scotorythra arboricolans* Butler, 1883.  
*Scotorythra rara brunnea* Warren, 1896, is raised to specific rank.  
*Scotorythra brachytarsa* Meyrick, 1899, is a new synonym of *Scotorythra brunnea* Warren, 1896.  
*Scotorythra isopora* Meyrick, 1899, is a new synonym of *Scotorythra caryopis* Meyrick, 1899.  
*Scotorythra aruraea* Meyrick, 1899, is a new synonym of *Scotorythra corticea* (Butler, 1881).  
*Nesoclide epixantha* Perkins, 1901, is transferred to *Scotorythra*.  
*Sisyrophyta gomphias* Meyrick, 1899, is transferred to *Scotorythra*.  
*Sisyrophyta ochetias* Meyrick, 1899, is transferred to *Scotorythra*.  
*Scotorythra idolias* Meyrick, 1899, is a new synonym of *Scotorythra paludicola* (Butler, 1879).  
The genus *Acrodrepanis* Perkins, 1901, is reduced to a subgenus of *Scotorythra*.  
*Acrodrepanis megalophylla* (Meyrick, 1899) is now *Scotorythra* (*Acrodrepanis*) *megalophylla* (Meyrick).  
*Acrodrepanis nesiotes* Perkins, 1901, is now *Scotorythra* (*Acrodrepanis*) *nesiotes* (Perkins).  
*Eucymatoge craterias ditrecta* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge dryinombra* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge niphoreas* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge orichloris* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge monticolans* (Butler) Meyrick, 1899, is returned to *Eupithecia*.  
*Eucymatoge rhodopyra* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge scoriodes* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eupithecia staurophragma* Meyrick, 1899, is transferred to *Eupithecia*.  
*Eucymatoge stypheliae* Swezey, 1948, is transferred to *Eupithecia*.  
*Fletcherana*, new genus, is erected.  
*Hydriomena giffardi* Swezey, 1913, is transferred to *Fletcherana*.

*Xanthorhoe insularis* (Butler, 1879) is transferred to *Fletcherana* as type of the new genus.

*Xanthorhoe ioxantha* Meyrick, 1899, is transferred to *Fletcherana*.

*Hydriomena leucoxylla* (Meyrick, 1899) is transferred to *Fletcherana*.

*Hydriomena roseata* Swezey, 1913, is transferred to *Fletcherana*.

*Ziela*, a new subgenus, is erected in *Progonostola* Meyrick, 1899.

*Xanthorhoe caustoscia* Meyrick, 1899, is transferred to *Progonostola* (*Ziela*) as type of the new subgenus.

*Megalotica*, new genus, is erected.

*Dasyuris holombra* Meyrick, 1899, is transferred to *Megalotica* as type of the new genus.

*Gela*, a new subgenus, is erected in *Megalotica*.

*Hydriomena aphoristis* Meyrick, 1899, is transferred to *Megalotica* (*Gela*) as type of the new subgenus.

## NOCTUIDAE

*Euxoa arenivolans* (Butler) Hampson, 1903, is returned to *Agrotis*.

*Euxoa aulacias* (Meyrick) Warren, 1912, is returned to *Agrotis*.

*Euxoa baliopa* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Euxoa bryani* Swezey, 1926, is transferred to *Agrotis*.

*Agrotis stenospila* Meyrick, 1928, is a new synonym of *Agrotis ceramophaea* Meyrick, 1899.

*Rhyacia ceramophaea* (Meyrick) Warren, 1912, is returned to *Agrotis*.

*Euxoa charmocrita* Meyrick, 1928, is transferred to *Agrotis*.

*Euxoa cremata* (Butler) Hampson, 1903, is returned to *Agrotis*.

*Rhyacia crinigera* (Butler) Warren, 1912, is returned to *Agrotis*.

*Euxoa dislocata* (Walker) Warren, 1912, is returned to *Agrotis*.

*Feltia lookii* Swezey, 1947, is a new synonym of *Agrotis dislocata* (Walker).

*Euxoa epicremna* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Peridroma fasciata* Rothschild, 1894, is transferred to *Agrotis*.

*Euxoa giffardi* Swezey, 1932, is transferred to *Agrotis*.

*Euxoa hephaestaea* (Meyrick), of authors, is returned to *Agrotis*.

*Euxoa kerri* Swezey, 1920, is transferred to *Agrotis*.

*Prodenia laysanensis* Rothschild, 1894, is transferred to *Agrotis*.

*Euxoa melanoneura* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Euxoa austalea* (Meyrick) Hampson, 1903, is a new synonym of *Agrotis melanoneura* Meyrick.

*Euxoa mesotoxa* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Agrotiphila microraeas* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Euxoa panoplias* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Euxoa perigramma* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

*Euxoa photophila* (Butler) Hampson, 1903, is returned to *Agrotis*, where Meyrick placed it in 1899.

*Euxoa procellaris* (Meyrick) Hampson, 1903, is returned to *Agrotis*.

- Euxoa psammophaea* (Meyrick) Hampson, 1903, is returned to *Agrotis*.  
*Euxoa tephrias* (Meyrick) Hampson, 1903, is returned to *Agrotis*.  
*Euxoa spoderopa* (Meyrick) Hampson, 1903, is a new synonym of *Agrotis tephrias* Meyrick, 1899.  
*Euxoa xiphias* (Meyrick) Warren, 1912, is returned to *Agrotis*.  
*Rhyacia coniotis albiorbis* Warren, 1912, is transferred to *Peridroma* and raised to specific rank.  
*Rhyacia chersotoides* (Butler) Warren, 1912, is transferred to *Peridroma*.  
*Rhyacia cinctipennis* (Butler) Warren is transferred to *Peridroma*.  
*Rhyacia cinctipennis* "ab." *albistigma* Warren, 1912, is transferred to *Peridroma* as a subspecies.  
*Rhyacia coniotis* ("coniotis") (Hampson) Warren, 1912, is transferred to *Peridroma*.  
*Rhyacia coniotis* ("coniotis") "ab." *rufata* Warren, 1912, is transferred to *Peridroma* as a subspecies.  
*Rhyacia neurogramma* (Meyrick) Warren, 1912, is transferred to *Peridroma*.  
*Rhyacia selenias* (Meyrick) Warren, 1912, is transferred to *Peridroma*.  
*Pseudaletia pyrrhias* (Meyrick) Franclemont, 1951, is a new synonym of *Pseudaletia macrosaris* (Meyrick).  
*Pseudaletia typhlodes* (Meyrick) Franclemont, 1951, is a new synonym of *Pseudaletia macrosaris* (Meyrick).  
*Haliophyle euclidias connexa* Warren, 1912, is raised to specific rank.  
*Haliophyle euclidias flavistigma* Warren, 1912, is raised to specific rank.  
*Aletia ferruginea* Swezey, 1932, is transferred to *Haliophyle*.  
*Eriopygodes euclidias depupillata* Strand, 1916, is a new synonym of *Haliophyle flavistigma* (Warren).  
*Haliophyle euclidias ignita* Warren, 1912, is raised to specific status.  
*Laphygma* Guenée, 1852, is a new synonym of *Spodoptera* Guenée, 1852.  
*Laphygma exempta* (Walker) Hampson, 1909, is transferred to *Spodoptera*.  
*Laphygma exigua* (Huebner) is transferred to *Spodoptera*.  
*Lophoplusia*, a new subgenus, is erected in *Plusia*.  
*Phytometra giffardi* (Swezey) Swezey is transferred to *Plusia* (*Lophoplusia*).  
*Phytometra psectrocera* Hampson is transferred to *Plusia* (*Lophoplusia*).  
*Phytometra pterygota* (Meyrick) Hampson, 1913, is transferred to *Plusia* (*Lophoplusia*).  
*Plusia violacea* (Swezey), Swezey, 1929, is transferred to *Plusia* (*Lophoplusia*).  
*Cosmophila vulpicolor* Meyrick, 1928, is transferred to *Gonitis*.  
*Gonitis hawaiiensis* Butler is not a synonym of "*Cosmophila*" *sabulifera* (Guenée) as stated by Meyrick, 1899; it is transferred to *Anomis* as a full species.  
*Cosmophila noctivolans* (Butler) Meyrick, 1899, is transferred to *Anomis*.  
*Hypocala andremona* "race *velans* (Walker)" Meyrick, 1899, is not a form of *andremona*; it is returned to full specific status.  
*Nesamiptis* Meyrick, 1899, is a new synonym of *Hypena* Schrank, 1802.  
*Nesamiptis laysanensis* Swezey, 1914, is transferred to *Hypena*.  
*Nesamiptis newelli* Swezey, 1912, is transferred to *Hypena*.

*Nesamiptis obsoleta* (Butler) Meyrick, 1899, is returned to *Hypena*.

*Nesamiptis plagiota* Meyrick, 1899, is transferred to *Hypena*.

*Nesamiptis proterortha* Meyrick, 1928, is a new synonym of *Hypena plagiota* (Meyrick).

*Nesamiptis senicula* Meyrick, 1928, is transferred to *Hypena*.

*Hypenodes altivolans* (Butler) Butler, 1881, is transferred to *Schrankia*.

*Hypenodes arrhecta* Meyrick, 1904, is transferred to *Schrankia*.

*Hypenodes oxygramma* Meyrick, 1899, is transferred to *Schrankia*.

*Hypenodes sarothrura* Meyrick, 1899, is transferred to *Schrankia*.

*Hypenodes altivolans simplex* Butler, 1881, is raised to specific status and transferred to *Schrankia*.

*Pseudoschrankia*, new genus, is erected.

*Hypenodes cyantias* Meyrick, 1899, is transferred to *Pseudoschrankia*.

*Hypenodes epichalca* Meyrick, 1899, is transferred to *Pseudoschrankia* as the type of the new genus.

*Hypenodes leptoxantha* Meyrick, 1904, is transferred to *Pseudoschrankia*.

*Hawaiiina* Tutt, 1903, is a new synonym of *Celerio* Oken, 1815.

*Hawaiiina perkinsi* (Swezey) Swezey, 1954, is reduced to a subspecies of *Celerio wilsoni* (Rothschild).

*Vaga*, new genus, is erected.

*Lycaena* (?) *ogasawaraensis* Pryer, 1886, is transferred to *Vaga*.

*Candalides blackburni* (Tuely) Gruenberg, 1922, is transferred to *Vaga* as the type of the new genus.

## Order **LEPIDOPTERA** Linnaeus

(*lepis*, scale; *ptera*, wings)

*Lepidoptera* Linnaeus, 1758:458.

*Farinosa* Schluga, 1767:36.

*Glossata* Fabricius, 1775:442.

### The Moths and Butterflies

The order Lepidoptera contains more than 100,000 described species, and tens of thousands more remain to be recorded. It is evidently the fourth largest order of insects, being outranked by the Coleoptera, Diptera and Hymenoptera. Because the order has had popular appeal and attracted many workers over a long period of time, there are at present more described species of Lepidoptera in the world than of Diptera or Hymenoptera and a larger proportion of the Lepidoptera are known. In regions where the major orders have received more equal attention, the Lepidoptera are shown to be outnumbered by the Coleoptera, Diptera and Hymenoptera

Some workers recognize about 100 families of Lepidoptera, whereas others recognize double this number. It is impossible to state here how many families there are, because few authors agree on the classification. Over a century and a half ago, Latreille said that the classification of the Lepidoptera was a disgrace to entomology; his words are still true. Most of the classification is based largely upon superficial characters, and the really important morphological details, which are normally hidden beneath the scales, have received comparatively little attention, although the situation has in recent years been improving. One of the best aids a lepidopterist could possibly have would be an instrument which would, perhaps at the touch of a switch, blow the scales off, thus leaving the specimen denuded and with all sclerites exposed for study on the dried animal. Until workers look beneath the scales and beyond the veins of the wings, no reliable classification can be erected. A satisfactory classification is yet to be written.

No order of insects has received so much attention from so many writers as has the Lepidoptera. The pertinent literature is enormous. In view of the many books which contain detailed accounts of the group, I might refrain from here giving a general discussion of the order and refer the student to the literature. However, to make this section of the encyclopedia agree in format with previous volumes, a brief digest will be included. I would, however, suggest that interested readers should consult such standard works as the textbooks by Imms, Comstock

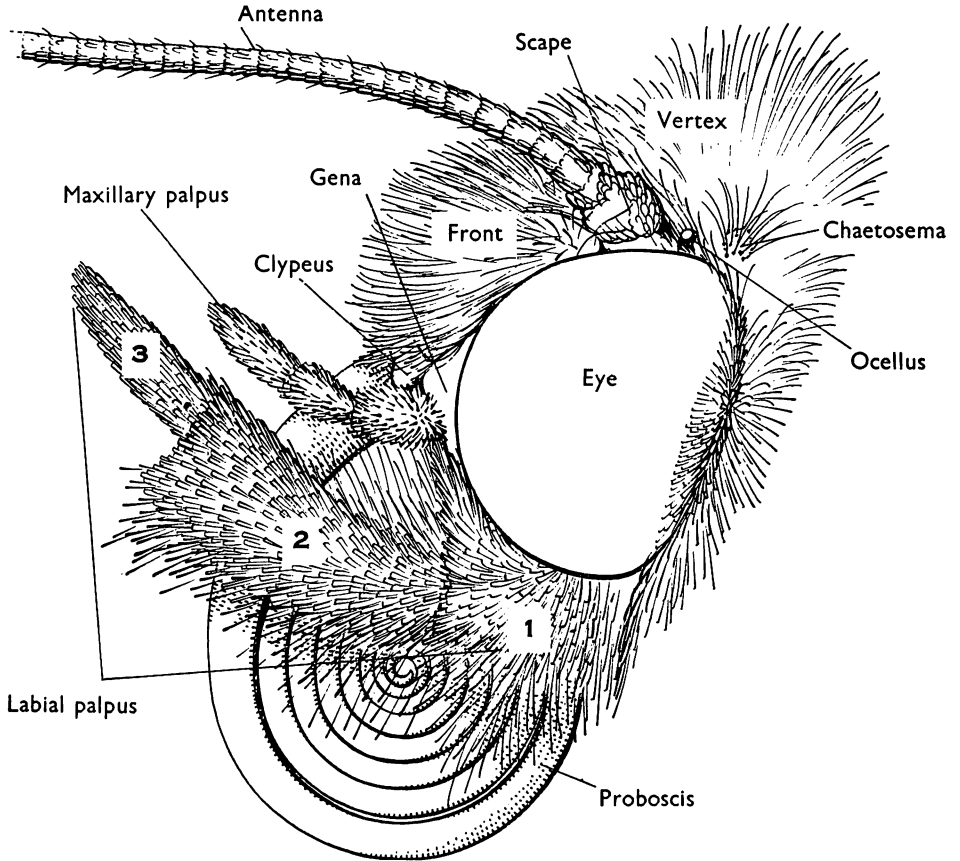


Figure 1—Head of a moth showing some parts used in classification.

and others, and Sharp's excellent and most readable volume in *The Cambridge Natural History*, Tillyard's *Insects of Australia and New Zealand*, the volumes by Hampson and others in *The Fauna of British India*, and similar works. A mine of information is to be found in Tutt's *Natural History of British Lepidoptera* and in Scudder's *Butterflies of the Eastern United States and Canada with Special Reference to New England* (one of the most outstanding works in the history of American entomology). I will refer the reader to the standard texts (also Kusnezof, 1915, 1929) for detailed accounts of the morphology and internal anatomy and shall not enter those fields here. This introduction could easily be expanded to fill a large volume, and then further volumes would be needed to continue a summary which could be called an "introduction" to the order. A brief summary of some of the characters of the order follows.

The Lepidoptera are closely related to the Trichoptera, and some of the more primitive forms might almost be referred to as squamose Trichoptera. Minute to very large insects (including the largest living insects, if the wing area is con-

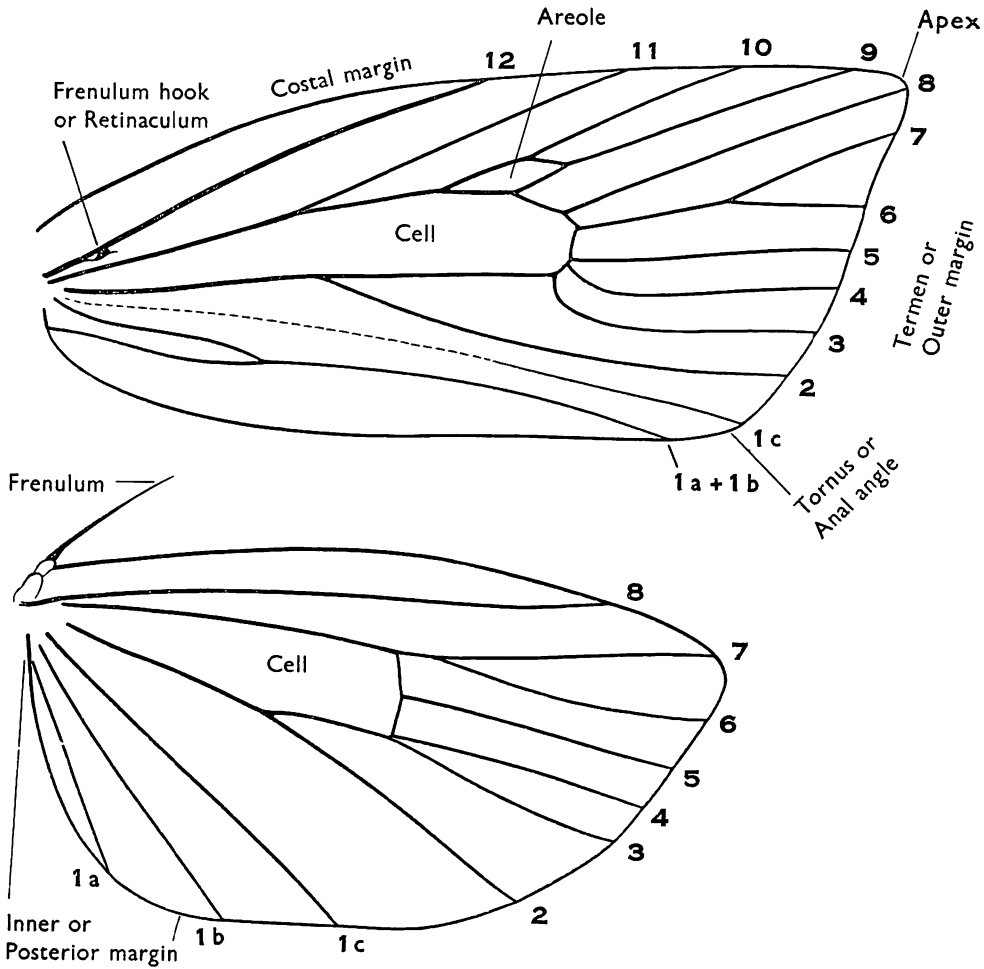


Figure 2—Fore and hind wings of a moth to show features used in classification.

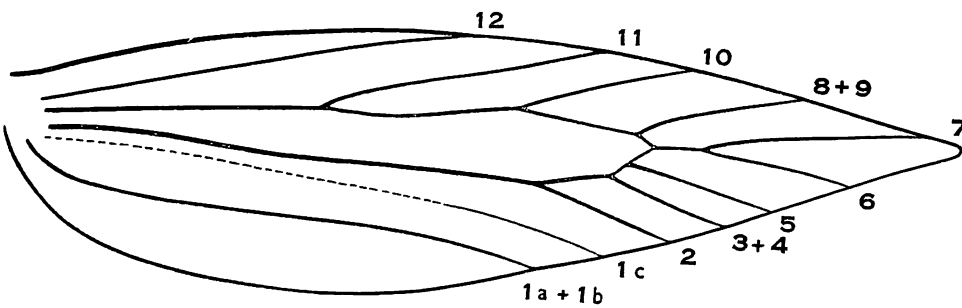


Figure 3—Fore wing of a small moth to illustrate reduced venation.

sidered); bodies well sclerotized and pigmented, with usually densely squamose wings and densely hairy or hairy and squamose bodies; often with great beauty expressed in the color and pattern of the scaling. Head hypognathous, fully exposed and free; compound eyes (Eltringham, 1919) very large, occupying most of each side of the head and containing large numbers of ommatidia; two ocelli present, or ocelli absent (if present, one ocellus is located behind each antenna). A *chaetosema*, or *Jordan's organ* (Jordan, 1923) (a setose organ of variable shape, but generally round or ovate and sometimes transverse), may or may not be present behind the ocelli (or the position they would take if present); antennae long, multisegmented and variable, filiform to plumose, much shorter to much longer than the wings; mouthparts highly modified; mandibles rudimentary or absent in all of our species, but present in certain primitive forms known elsewhere; maxillae unusually modified to form a characteristic, highly flexible, nectar-sucking proboscis of variable length (vestigial and non-functional in some species, not infrequently longer than the body and as long as 10 inches in some species) and which has the unusual capability of being tightly coiled like a spring beneath the head. On either side of the base of the proboscis is usually found a setose process called the *pilifer*. The maxillary palpi are variable, often rudimentary or absent; labium much reduced; labial palpi usually three-segmented and variable in size and shape, usually large and curved upward in front of face or porrect, but drooping in some forms. Prothorax reduced, usually bearing a pair of characteristic movable or erectile, dorso-lateral sclerites called *patagia*; mesothorax strongly developed and larger than the other thoracic somites, bearing well-developed, movable, anterior, dorso-lateral sclerites rather similar to patagia

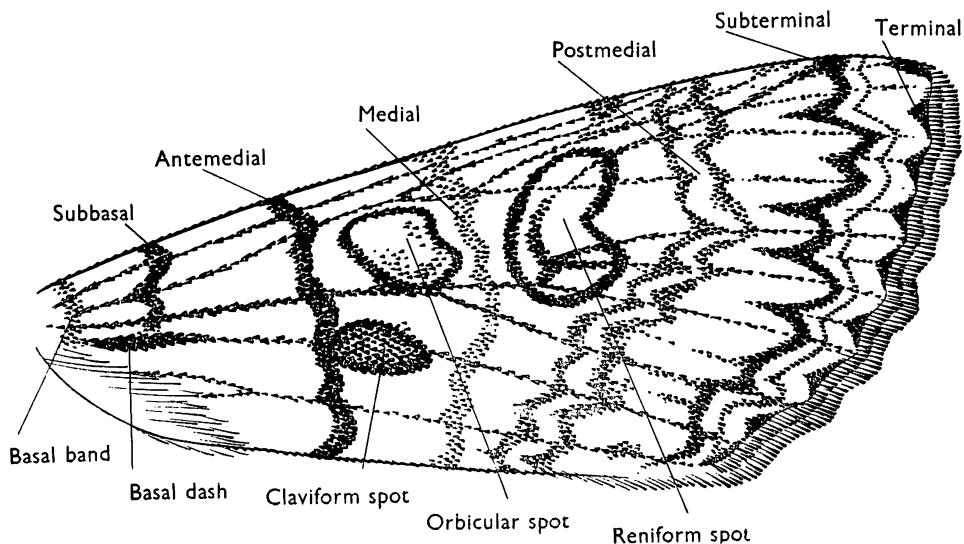


Figure 4—Fore wing of a moth to illustrate some of the markings used in classification.



and known as the *tegulae*, the largest sclerite of the notum is the mesoscutum, and behind this is the mesoscutellum which may be large or inflated; the metathorax is smaller, and the metascutum is usually represented by a pair of sclerites lying at either side of the apex of the mesoscutellum, and the metascutellum is narrow and forms a transverse band behind the two lobes of the metascutum. In some groups, such as the Noctuidae, the metathorax is highly modified by the development of the paired *tympanal organs* which may be complex and extraordinary. The four wings are membranous, usually well developed and very large for the size of the animal. Brachyptery is known only in some females; all known males have fully developed wings. The fore wings overlap the hind wings, and at rest the wings may be held roof-like, horizontal or folded together vertically over the back. In most of our species the hind wing bears at the base of the costal margin the *frenulum* (Braun, 1924) for coupling the wings together. This consists of a bundle of spines which are fused into what appears to be a single spine in the

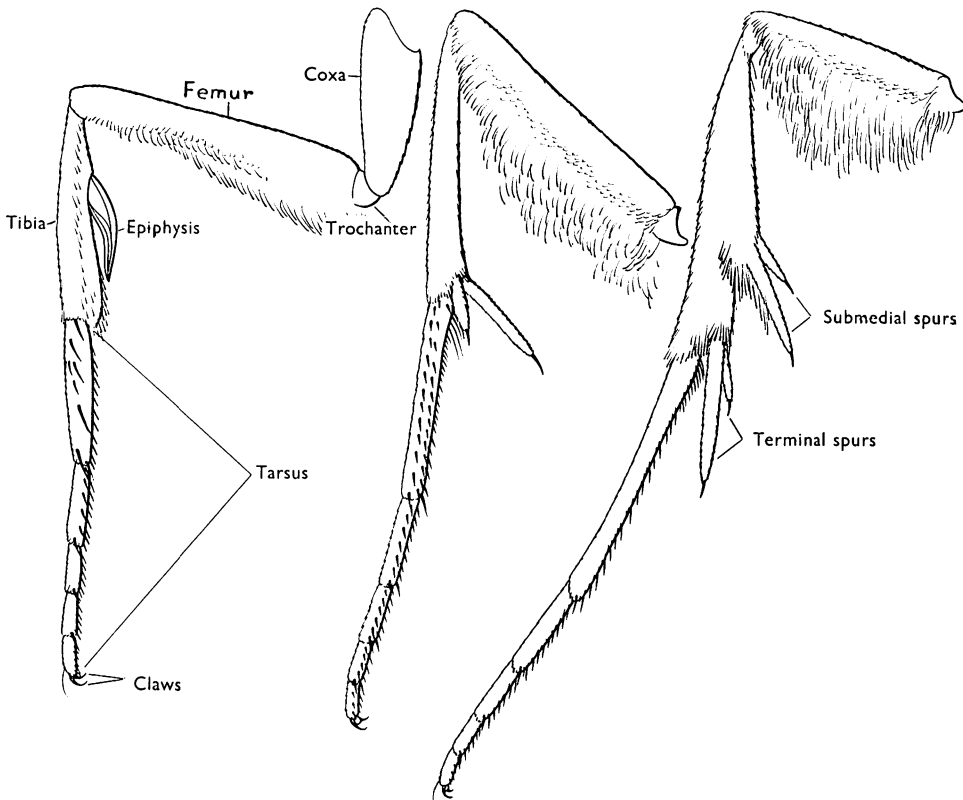


Figure 5—The legs from one side of a moth. From left to right: Fore, mid, and hind.

males; the frenulum is multiple in most females (there appears to be no sexual differences in some groups). The frenulum hooks into a catch, the *retinaculum* (Braun, 1924), on the underside of the fore wing, and the retinaculum is in the subcostal area in the male but along the posterior side of the cell in the female (an unusual sexual variation). The wings are characteristically densely clothed with imbricated scales. The venation consists of a variable number of longitudinal veins, and at most few or no cross-veins; a common number of veins is 12 in the fore wing and 8 in the hind wing, and most species have only one cell. Many species have the venation much reduced and modified. Several systems have been evolved for naming the veins, but none has received universal acceptance. A simple system of numbering the veins was adopted long ago by Herrich-Schaeffer and has long remained in use. For the sake of simplicity and ease of use by non-specialists, I have used the number system in this text. Some of the small species have long fringes of hairs on the wings and thus the wing area is increased in flight. Legs ambulatory; usually long and slender; anterior legs reduced or modified in some families; coxae usually very long and more or less rigidly fixed to the thorax, the main articulation being at the trochanter; anterior tibia usually with a peculiar, modified, spur-like organ, the *epiphysis*, which may be used to clean the antennae; middle tibiae with a pair of subterminal spurs, often large, and

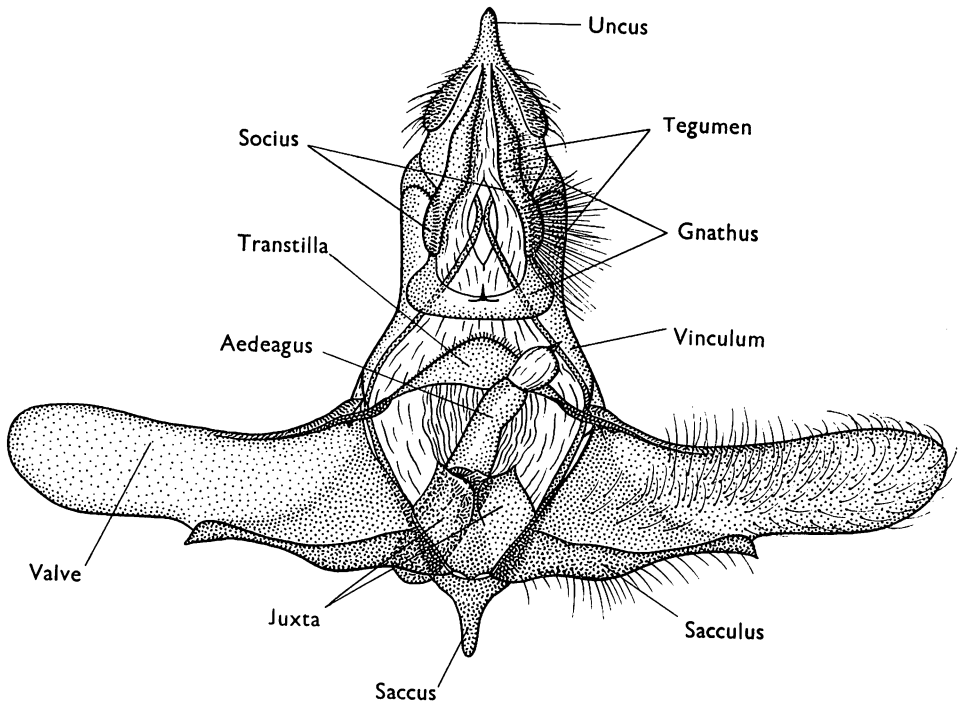


Figure 6—Male genitalia of a moth, spread open. (Modified from Torre-Bueno.)

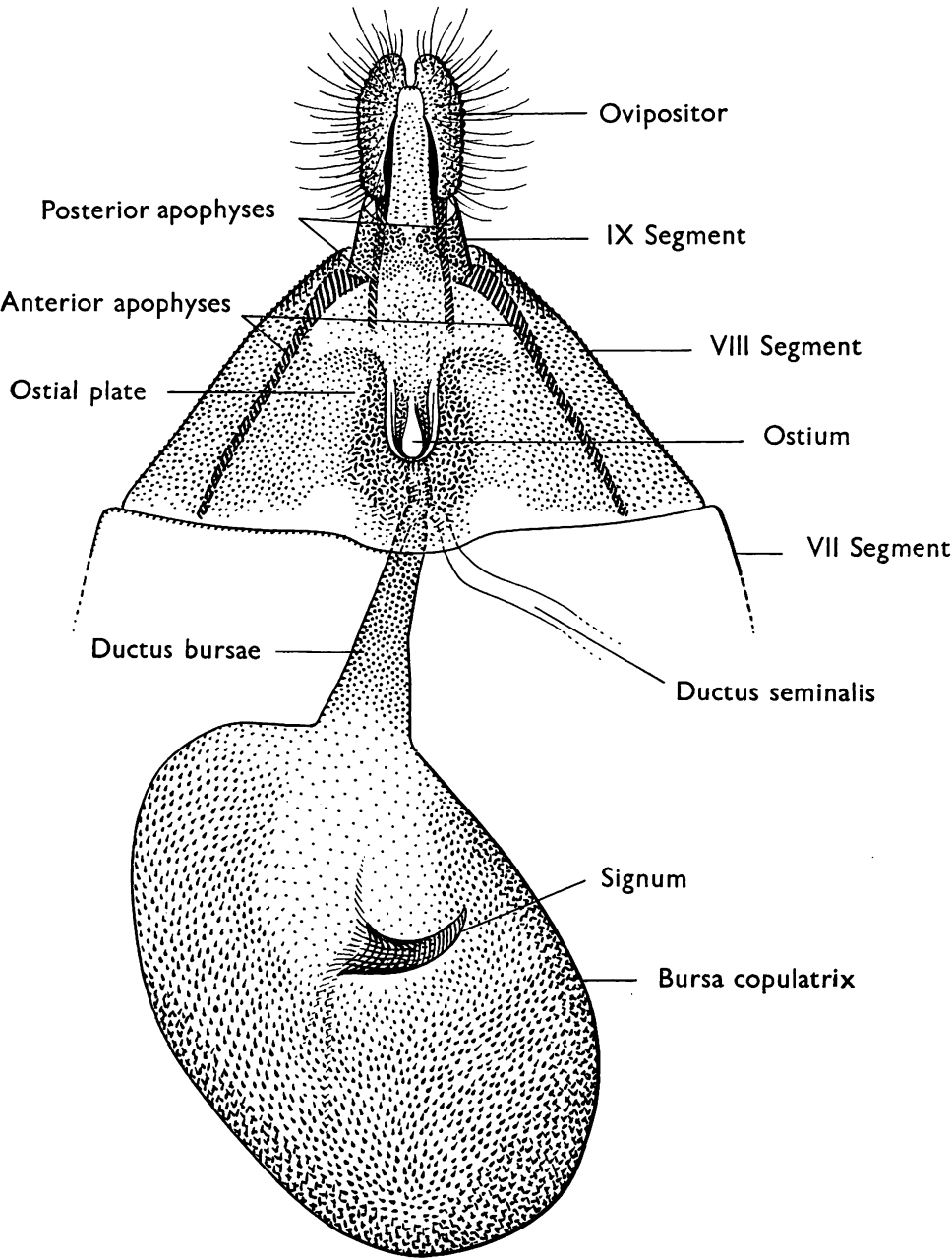


Figure 7—Female genitalia of a moth.

hind tibiae usually with a submedial and subterminal pair of similar spurs, often large and variously modified; tarsi normally five-segmented, claws variable, simple, toothed or cleft, pulvillus and paronychium usually developed. The abdomen consists basically of 10 segments, the first of which has a reduced tergum and the sternum may be invisible, usually only seven or eight tergites are distinct, the remainder being incorporated in the genitalia; cerci not evident; ovipositor variable, often telescopic and very long; a complex, often highly developed paired *tympanal organ* is situated in the base of the abdomen in some groups (see the Geometridae). Metamorphosis complete. Eggs variformed (Döring, 1955), flat to convex to spindle-shaped, often highly ornamented with surface sculpture and objects of great beauty; laid free, cemented to various objects or deposited in crevices, etc., singly or in clusters of various sizes, often in large masses, sometimes glued end to end in chains or "sticks." The pattern and mode of placement of the eggs is often of specific nature. Larvae (Dyar, 1894; Fracker, 1915, 1930; Hinton, 1946; Peterson, 1948) variform, usually vermiform, and with the three pairs of thoracic legs well developed, but sometimes modified; usually with abdominal

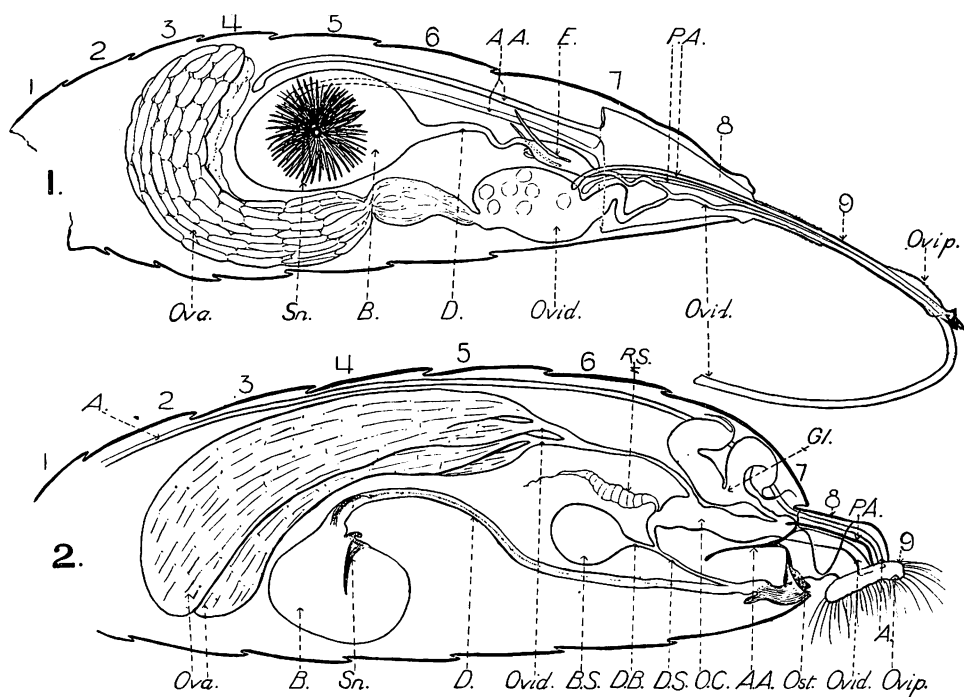


Figure 7-A—Schematic longitudinal sections through the abdomens of (1) a moth with one sex opening, and (2) one with two sex openings. Abbreviations: 1-9, the abdominal segments; A, alimentary canal; A.A., anterior apophyses; B, bursa copulatrix; B.S., bulla seminalis; D, ductus bursae; D.B., ductus bullae; D.S., ductus seminalis; E, enlarged part of ductus bursae; Gl., gland; O.C., common oviduct; Ost., ostium; Ova., ovaries; Ovid., oviducts; Ovip., ovipositor; P.A., posterior apophyses; R.S., receptaculum seminalis; Sn., signum. (After Busck, 1931.)

prolegs on the tenth segment and on one or more of segments three to six, these prolegs with various arrangements of ventral hooks called *crochets*. Larvae generally herbivores, but some predaceous (including some which feed upon coccids), mostly terrestrial, but a few subaquatic or aquatic with well-developed gills. Pupae (Mosher, 1916; Poulton, 1890) free and exposed, or enclosed in a cocoon or earthen cell.

The genitalia are much used in classification and identification, and many papers have been written about the organs. But much confusion in nomenclature exists, and a definitive report has yet to be written. The student may consult the following papers (and many others) which are listed in the bibliography for information: Beirne, 1942, 1944; Bennett, 1929; Bethune-Baker, 1915; Busck, 1931, 1942; Busck and Heinrich, 1921; Clarke, 1941; Diakonoff, 1954; Eecke, 1918; Eyer, 1924; Forbes, 1939; Gosse, 1882; Hewer, 1932; Hulst, 1895; Mehta, 1933; McDunnough, 1911 (see note on harpe and valve in bibliography); Newell, 1918; Pierce, 1909, 1914, 1942; Pierce and Metcalf, 1922, 1935, 1938; Riley, 1892; Tams, 1926; Turner, 1915 (includes a bibliography to 1915), White, 1878. Several important works have been issued since this manuscript was written.

The Lepidoptera is one of the geologically younger orders of insects. The oldest known fossils belong to the early Tertiary and the order probably had its beginning in upper Cretaceous times (Scudder, 1875; Forbes, 1932).

The order is geographically widespread, and some species are renowned wanderers which fly for long distances, even across oceans. Some species are migratory (Pagenstecher, 1909; C. B. Williams, 1930).

Included in the Lepidoptera are some of the most important pests of the insect world, and enormous damage is done annually by their ravages. Not only do the larvae of many species destroy crops used for food by man and his animals, but forests are damaged and clothing and many kinds of harvested, stored, dried and prepared foods are attacked. The amount of money expended on the control of caterpillars is stupendous. On the other hand, a number of species have been used in the control of noxious plants with outstanding success (for example, *Cactoblastis* against *Opuntia*, the prickly pear cactus).

There are about a thousand recorded species of Lepidoptera in Hawaii, and numbers of new species remain to be described. I am not describing new species in this text; if I did, this monograph would never be completed, because I could spend the rest of my life searching for and describing new species of Hawaiian moths. This series of books is meant to "take stock" of what we now know of the insects of the Hawaiian Islands.

In spite of what some may believe, we know comparatively little about the Lepidoptera of Hawaii, and a vast amount of information remains to be recorded. Now that I have completed some of my work on the group, I realize, better than ever before, how much is yet to be done. I can do only a little here, but, at least, these volumes will serve as an introduction to the study of the Hawaiian Lepidoptera, and one of their most valuable features is the revelation of our enormous ignorance.

I now draw the task to a close, not because it is completed—it is an unfinished

product which can never be completed—but it is now necessary that I turn my attention to other matters. Many lifetimes could be spent in concentrated study of the Hawaiian Lepidoptera. We may consider how much remains yet to be done on the lepidopterous fauna of England, yet hundreds of workers have concentrated on the study of that fauna for over two centuries. One person can hardly be expected to complete the study of the Lepidoptera of Hawaii, and here only a gross sorting has been made. It now remains for others to build upon the incomplete foundation. Now that this preliminary report is completed, it would be advisable that I return to Hawaii to use, expand and correct the manuscript for an extended period before it is published; but that, regrettably, is not possible.

The writing of the text on the Hawaiian moths has been the most difficult, frustrating and ungratifying exercise of my scientific career, and I am far from satisfied with the results. I have often thought that hardly anything could be more discouraging and frustrating and lead one to consider discontinuing this series of volumes than the attempt to “unravel” the Lepidoptera. It should be a lifetime assignment. Let us consider just a few small points from the literature alone, to say nothing of the complex problems involving the animals themselves: Hampson refers to densely squamose palpi as “naked” in certain pyraustids. Meyrick says that ocelli are present in one group, but Forbes says they are absent. Forbes says that a vein is absent in the fore wing of one subfamily, yet the members of the type genus have that vein. For another group, Forbes says “tongue very weak or obsolete,” Hampson says “Proboscis usually well-developed” and Meyrick says “tongue usually short”! Such contradictions in the literature on Lepidoptera are legion. What a muddle we have to contend with! What is the unfortunate student to do?

As in the other volumes of this series, descriptive matter is incorporated in the keys, and separate descriptions are not given under each specific heading. If further details are required, the original descriptions should be consulted, and, most fortunately, most of them are included in *Fauna Hawaiiensis* and *Proceedings of the Hawaiian Entomological Society*. This text is written with the understanding that these two works must be used in conjunction with it.

## HISTORY OF THE STUDY OF THE HAWAIIAN LEPIDOPTERA

The first Hawaiian insect collection was made in 1778–79 by Sir Joseph Banks who accompanied Captain Cook, but no Lepidoptera were described from his collection. The first species of Lepidoptera recorded from Hawaii was *Vanessa tameamea*, King Kamehameha's butterfly, which was described in 1821 by Dr. J. F. Eschscholtz, the surgeon-naturalist (after whom the California poppy, *Eschscholtzia* is named), who collected specimens while accompanying Captain Kotzebue's Russian expedition to the South Seas and Bering Straits in the years 1815–1818. The first moths recorded from the Islands were *Agrotis dislocata* and *Hypocala velans*, which were collected by Captain Beechey's expedition to the Pacific and Bering Straits in 1825–1828 and described by the English entomologist Francis Walker in 1856 and 1857, respectively.

There was then a long period of silence on the Hawaiian Lepidoptera until the Rev. Thomas Blackburn, the English clergyman and able amateur entomologist, went to Hawaii in 1876 and collected until 1882. Blackburn sent collections of Lepidoptera back home to A. G. Butler, who reported on them in a series of papers between 1877 and 1883 (see bibliography). Edward Meyrick also described some of the Blackburn collection and collected briefly on his way to New Zealand in 1883.

In 1892, R. C. L. Perkins, the brilliant English naturalist, began his historical natural history survey of Hawaii under the auspices of the Royal Society and the British Association for the Advancement of Science. Perkins' collection of Hawaiian Lepidoptera is the largest ever assembled, and a large number of the species taken by him have not been collected since. Perkins took great care in collecting and preparing his material, and most of it is well preserved. In spite of all the work done since his time, the individual contributions of Perkins exceed the combined efforts of all others.

The ground work for Hawaiian lepidopterology was founded upon the great Perkins' collections by Edward Meyrick, who, in 1899, monographed the Macrolepidoptera and Pyrales in *Fauna Hawaiiensis*, and by Lord Walsingham who, in 1907, in the same classic work, published his monograph of the Microlepidoptera. Meyrick's report included 49 genera and 292 species; of these, 6 genera and 200 species were described as new, and a number of additional species were for the first time listed from Hawaii. Walsingham's report treated 62 genera and 441 species, of which 406 species were for the first time recorded from Hawaii, and 20 of the genera were described as new. In 1904, Meyrick published a supplement to the Lepidoptera sections of *Fauna Hawaiiensis* in which 4 genera and 16 species were added from the Perkins' collections. Thus, these three reports assembled records of 115 genera and 759 species of Hawaiian Lepidoptera. Only about 250 species have been added to the list in the past 50 years to bring the total to about a thousand species (compared with about 2,200 species in Britain).

After Dr. Perkins completed his faunal survey work at the end of 1901, he was called by the Hawaiian Government to join the Agricultural Department, where he served from 1902 to 1904. In 1904 he accepted the post of Director of the new

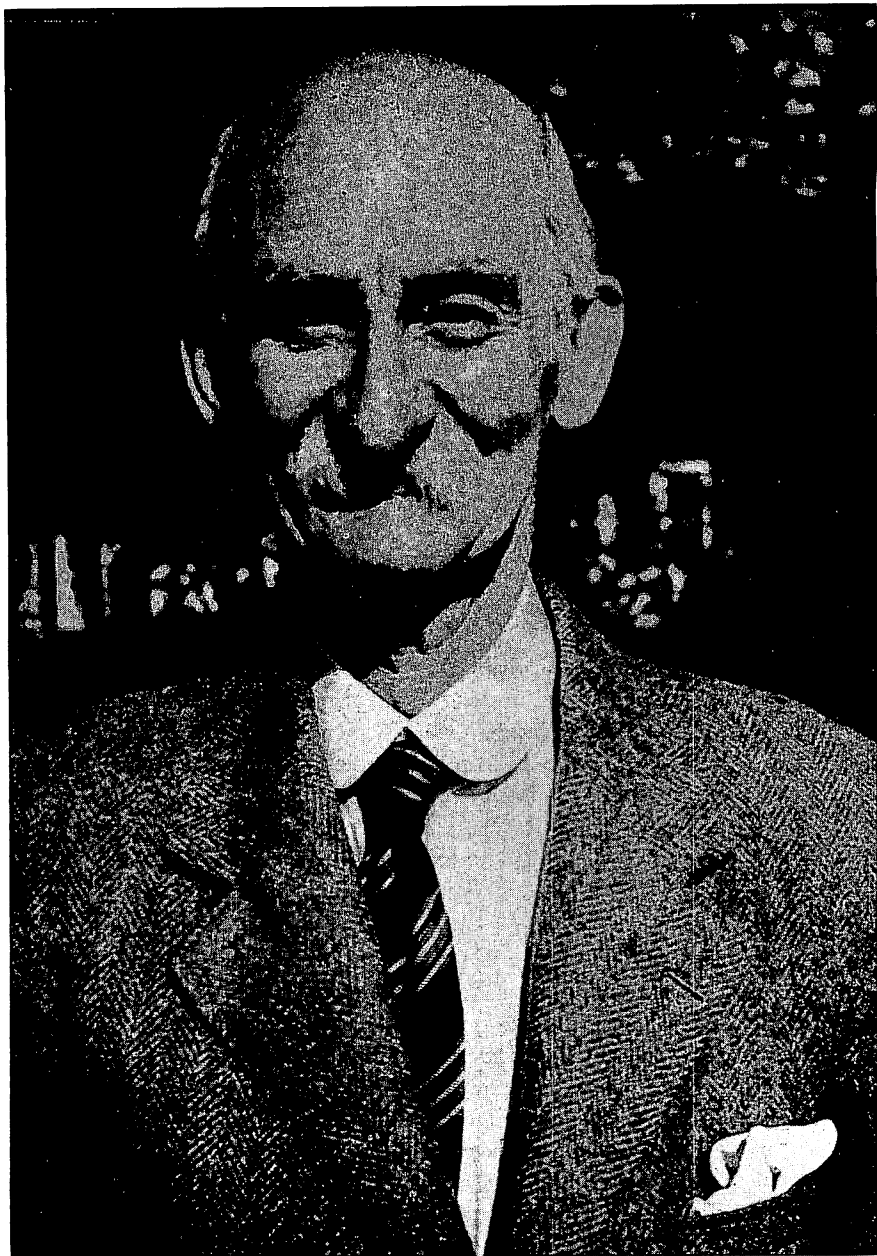


Figure 8—R. C. L. Perkins, nearly 83 years of age (from a photograph taken by the author in Devonshire, August 31, 1949).



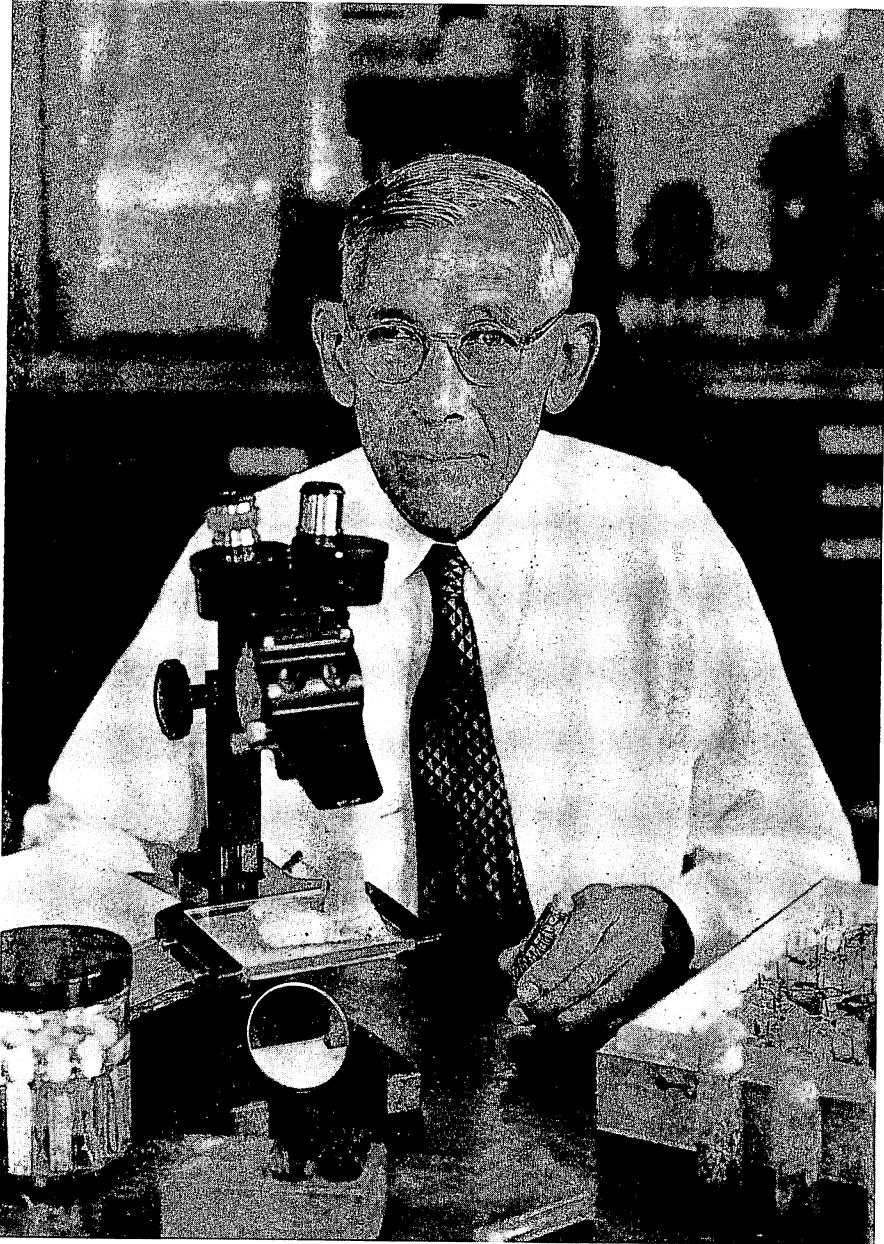


Figure 9—O. H. Swezey, at age 75 years (Experiment Station, Hawaiian Sugar Planters' Association, August, 1944.)

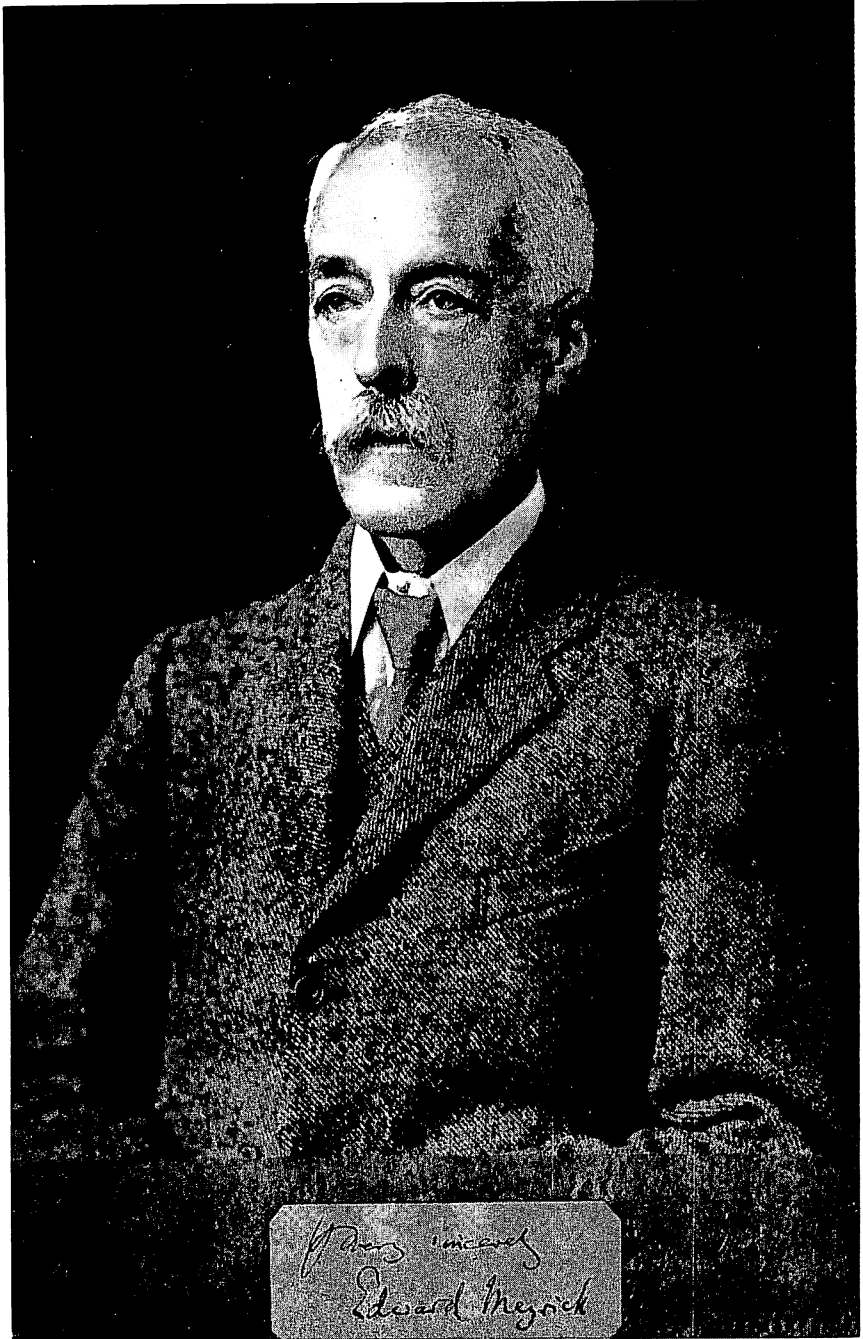


Figure 10—Edward Meyrick (courtesy, British Museum (Natural History) ).

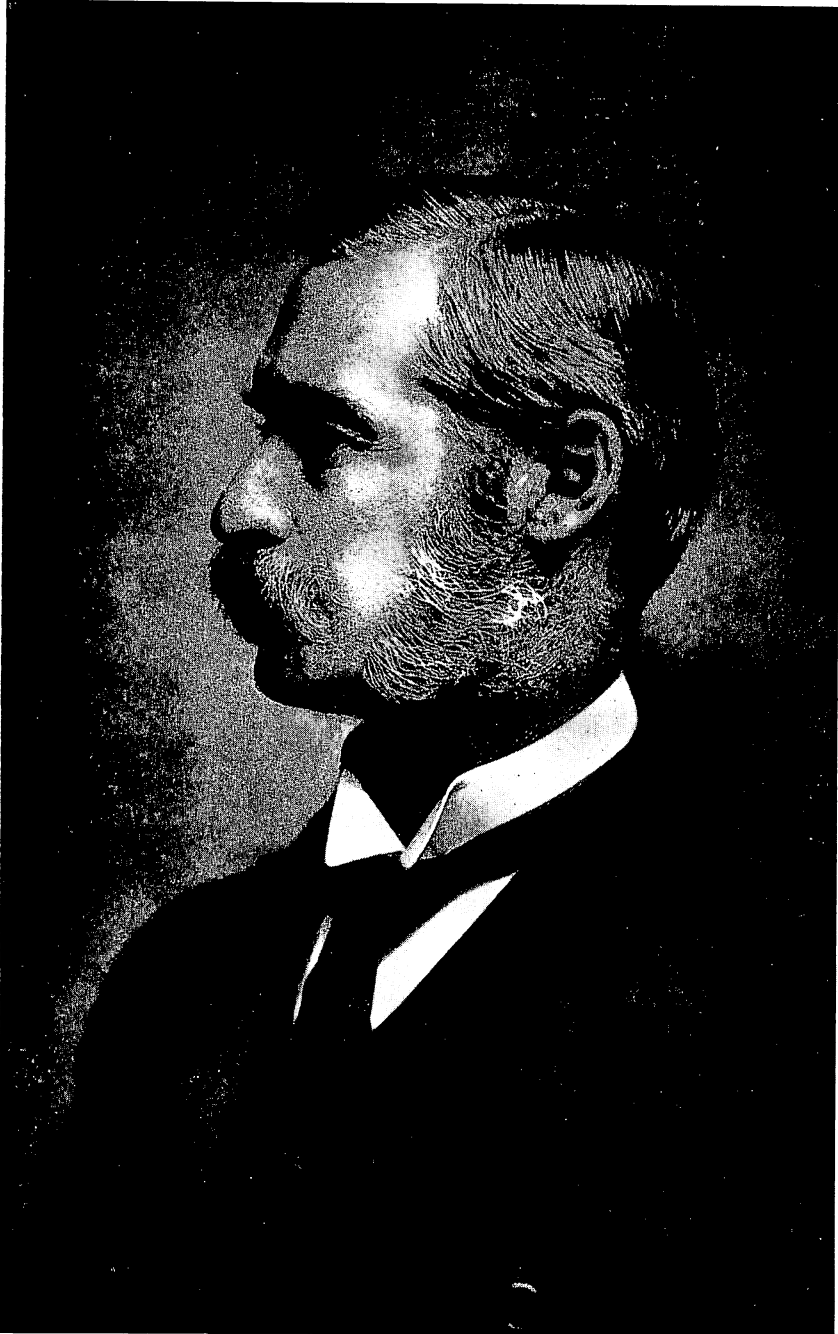


Figure 11—Lord Walsingham (courtesy, British Museum (Natural History) ).

Division of Entomology at the Hawaiian Sugar Planters' Experiment Station in Honolulu. He returned to England in 1912, and, because of illness, he retired and never returned to Hawaii. He settled in Devonshire, where he lived until his death in September, 1955, at the age of 88.

In 1904, Perkins added to his staff O. H. Swezey, who had been a student of leafhoppers under Prof. Herbert Osborn in Ohio. Swezey soon began to study the Hawaiian Lepidoptera with special attention to their life histories, and he largely specialized in Lepidoptera and forest entomology for almost 50 years until he left Hawaii in 1952 to live in retirement in San Jose, California. Dr. Swezey was absolutely devoted to his studies, and he assembled an enormous mass of records on the biologies of Hawaiian insects. We are indebted to him for the bulk of our knowledge of the habits, hostplants, parasites and early stages of the Hawaiian Lepidoptera. Interested principally in life histories and hostplant relationships, Dr. Swezey made no special effort to describe new species, although he did describe many species of moths. He sent many of the new species he discovered to Meyrick, who described them, mostly in the *Proceedings of the Hawaiian Entomological Society* and in his privately printed *Exotic Microlepidoptera*. Swezey was very active during his half century in Hawaii, and his written contributions to Hawaiian lepidopterology form a continuous record in the *Proceedings of the Hawaiian Entomological Society*.

When Dr. Swezey laid down his pen and left Hawaii, a golden era of Hawaiian entomology closed. He belonged to that school of men who seek after knowledge for its own sake.

Swezey was the last of the entomologists to have seen many of the endemic Hawaiian Lepidoptera in a semblance of their natural abundance. The importation of parasites to control various moths of economic importance, together with the accidental importation of other parasites has resulted in wholesale slaughter and near or complete extermination of countless species. It is now impossible to see the Hawaiian Lepidoptera in the natural proliferation of species and individuals of Perkins' day. Many are forever lost.

It is noteworthy that, with the exception of the American Swezey, all the significant contributions to Hawaiian lepidopterology were made by Englishmen—Blackburn, Butler, Perkins, Meyrick and Walsingham. In all modern history, no nation has ever equalled the monumental contributions to natural history made by little England, mother of naturalists.

TABULAR ANALYSIS OF THE HAWAIIAN MACROLEPIDOPTERA

FAMILY	GENERA	ENDEMIC GENERA	NON-ENDEMIC GENERA	SPECIES	ENDEMIC SPECIES	ADVENTIVE SPECIES
Geometridae	10	8	2	59	58	1
Noctuidae	26	3	23	90	66	24
Sphingidae	4	1	3	9	6	3
Pieridae	1	0	1	1	0	1
Nymphalidae	1	0	1	4	1	3
Danaidae	1	0	1	1	0	1
Lycaenidae	3	0	3	4	1	3
Totals	46	12	34	168	132	36

Number of genera containing endemic species: 25.

Number of genera containing adventive species: 28.

Number of genera containing only endemic species: 18.

Number of genera containing only adventive species: 21.

Number of genera containing both endemic and adventive species: 7.

Percentage of endemism in native group: genera, 52 percent; species, 100 percent.

Percentage of present-day fauna endemic: 78.5 percent.

Percentage of present-day fauna adventive: 21.4 percent.

Average number of species per genus in endemic group: 5.28.

Average number of species per genus in adventive group: 1.28.

For simplification, I have included subgenera and subspecies in the totals of genera and species.

The figures in this and similar tables in this work may be explained as follows:

1. "Percentage of endemism in native group: genera" means the percentage obtained by dividing the number of endemic genera by the total number of genera containing native (endemic and indigenous) species. (In this case, 48 percent of the genera which contain endemic species are themselves endemic.)

2. "Percentage of endemism in native group: species" means the percentage obtained by dividing the number of endemic species by the total number of endemic plus indigenous species.

3. "Percentage of present-day fauna native" is obtained by dividing the total number of endemic plus indigenous species by the total number of species recorded from the islands (endemic + indigenous + adventive).

4. "Percentage of present-day fauna adventive" is, similarly, the total number of species divided into the total of adventive species.

5. The average number of species per genus is obtained simply by dividing the total number of species in the native or adventive group by the total number of genera containing those species.

We may now compare with profit some of the categories of the foregoing analysis with similar analyses of some other orders containing Hawaiian insects monographed in previous volumes of this series (see table on next page).

The average number of species per genus in the native Heteroptera is too low as indicated here, because there is a large number of new endemic species which await description in groups which have not yet been monographed. In the Homoptera, the higher average number of species per genus in the adventive group is caused by the large number of aphids and coccids accidentally introduced by man.

## OTHER ORDERS COMPARED WITH MACROLEPIDOPTERA

	ORTHOP- TERA	CORRO- DENTIA	ODO- NATA	HETER- OPTERA	HOMOP- TERA	NEURO- TERA	MACRO- LEPIDOPTERA
Endemic percentage of all genera containing endemic species	100	66.7	66.7	67.2	88	75	52
Percentage of present- day fauna endemic	54	60	85	80.7	68	87	78.5
Average number of species per genus in native group	9	8	9.7	5.4	12	9.5	5.3
Average number of species per genus in adventive group	1.2	1.3	1	1.1	2	1.1	1.3

## DERIVATION OF THE HAWAIIAN MACROLEPIDOPTERA

When the "Summary of the Lepidoptera" for the analysis of the Hawaiian lepidopterous fauna in Volume 1 (pp. 76-77) of this series was written, some strong statements were made regarding the "chaos which exists in the classification of the Lepidoptera," and it was pointed out that the analysis "has many weak spots." Now that opportunity has been had to study the Lepidoptera in some detail, it may be said that the criticisms voiced in Volume 1 were not too strong, and that some of them were perhaps understatements. I now consider the "Summary of the Lepidoptera" in Volume 1 to be in large part misleading and worthless, although it does contain a modicum of truth here and there. Although I have since been able to concentrate on a study of the Hawaiian Lepidoptera, I am still unable to present a satisfactory analysis of the fauna, and the story of the relationships and derivations of the Hawaiian Lepidoptera remain largely to be determined.

In this present volume are listed 168 Macrolepidoptera, and 132 of these are considered endemic. The other 36 are foreign insects, all or almost all of which have become established in the islands through the aid of man.

The 36 immigrant or introduced species are included in 28 genera and subgenera, and they represent about as many separate introductions as species. Of the 36 species, 22 (including two uncertain) have come from America and the remaining 14 species have come from the Pacific.

The 25 genera and subgenera which contain endemic species evidently represent about 19 or 20 ancestral invasions, and these may be tabulated tentatively as follows, according to my present interpretations:

TABULAR SUMMARY OF THE ENDEMIC HAWAIIAN MACROLEPIDOPTERA

FAMILY	GENUS OR (SUBGENUS)	NUMBER OF SPECIES	SOURCE OF ANCESTRAL INVASION			
			Pacific	American	Boreal	Unknown
Geometridae	<i>Scotorythra</i> (35) & derivatives: ( <i>Acrodrepanis</i> 2), <i>Tritocleis</i> (1)	38	1			
	<i>Eupithecia</i>	11			1	
	<i>Fletcherana</i> <i>Progonostola</i> (1) ( <i>Ziela</i> 1) <i>Megalotica</i> (1) ( <i>Gela</i> 1)	5 2 2			1 (or 2?)	
Noctuidae	<i>Agrotis</i>	26			1	
	<i>Peridroma</i>	8			1	
	<i>Pseudaletia</i>	3		1		
	<i>Haliophyle</i>	8				1
	<i>Plusia</i> ( <i>Lophoplusia</i> )	4			1	
	<i>Gonitis</i>	1	1			
	<i>Anomis</i>	2	1?			
	<i>Hypocala</i>	1	1			
	<i>Hypena</i>	5			1?	
	<i>Schrankia</i>	5			1	
	<i>Pseudoschrankia</i>	3				1
Sphingidae	<i>Tinostoma</i>	1		1		
	<i>Celerio</i>	4		1		
	<i>Phlegethontius</i>	1		1		
Nymphalidae	<i>Vanessa</i>	1	1			
Lycaenidae	<i>Vaga</i>	1	1			
Totals	21 genera, 4 subgenera	132	6	4	7 (or 8?)	2

It is of special interest to note that only five of the many recognized families of the world's Macrolepidoptera have endemic species in Hawaii. It is impossible to tell at this time which of the Boreal stocks may have come from America and which from Asia, although I believe that further study may reveal the sources of most of these groups.

## CLASSIFICATION

Chaos reigns in the classification of the Lepidoptera, and it is difficult to find any two authors who accept the same arrangement of the families or recognize all of the same families. It is obvious, however, that Hawaii lacks many large groups. If we compare the Hawaiian faunal list with the Forbes 1923 manual (northeastern America), for example, we will find that the entire superfamilies Incurvarioidea, Zygaenoidea, Cynodioidea, Saturnioidea, Bombycoidea and Drepanoidea, as well as the suborder Jugatae of some workers—containing the Micropterygidae, Eriocraniidae and Hepialidae—are all without representatives in the native Hawaiian fauna. Many of the characteristic families of Lepidoptera of the continents are absent from Hawaii. Excepting for a few species of *Opostega*, all of the primitive groups are absent. The absence of the Oecophoridae is noteworthy, because this family is abundantly developed in the Australian region.

The taxonomy of the Lepidoptera has suffered greatly because of much superficial work largely at the hands of dilettanti. More than any other order, Lepidoptera has attracted workers whose scientific foundations have not been broad enough to enable them to apply proper principles in their studies. Much poor work continues at the present time and really belongs in the realm of stamp-collecting or similar hobbies and wears false colors under the guise of science. Happily, however, the trend is definitely toward improvement, and more and more workers are turning their attentions to more detailed, careful and scientific research. Hinton, a highly inquisitive and critical worker and not primarily a lepidopterist, but an active comparative morphologist, has in recent years interested himself in a number of problems concerning the classification of the Lepidoptera. In 1946:2, he had the following to say:

The Lepidoptera are now divided into two suborders: the Jugatae and Frenatae of Comstock and others and the Homoneura and Heteroneura of Tillyard, Imms, and many recent authors. Some authors still divide the order into Heterocera and Rhopalocera, which is absurd. There are many groups of families of comparable taxonomic rank to the Rhopalocera, so that if the series of families now included in the Rhopalocera is given subordinal rank, many new suborders would have to be erected. The division of the order as proposed by both Comstock and Tillyard has the defect of associating the Hepialidae with the very different Eriocraniidae in one suborder and placing the Incurvariidae, Adelidae, etc., which are far nearer to the Hepialidae as regards the majority of characters of all stages, in another suborder. The division of the Lepidoptera into Jugatae and Frenatae, has, among other defects, the curious result of placing the females of some of the more primitive Nepticulidae in the Jugatae and their males in the Frenatae.

Hinton recognizes three suborders: Dacnonypha Hinton, 1946:4, including the Eriocraniidae and Mnesarchaeidae; Monotrysia (Börner, 1939) Hinton, 1946:4, including the Hepialoidea, Nepticuloidea and Incurvarioidea; and the Ditrysia (Börner, 1939) Hinton, 1946:4, containing the remainder of the Lepidoptera. There are no members of the primitive Dacnonypha in Hawaii, and only a few species of *Opostega* represent the Monotrysia; all other Hawaiian Lepidoptera belong to the Ditrysia. The two suborders represented in Hawaii may be separated as follows:



KEY TO THE SUBORDERS OF LEPIDOPTERA IN HAWAII

1. Female with only one sex opening; wings with aculeae (in our species confined basad) (our species minute moths with greatly reduced venation and large antennal eye-caps).....**Monotrysia.**
2. Female with two sex openings: one through the ovipositor and a separate copulatory opening to the bursa copulatrix; wings without aculeae.....**Ditrysia.**

Suborder DITRYSIA

*Ditrysia* Börner, 1939:1423. Hinton, 1946:4, redefined.

The names Rhopalocera and Heterocera have been so widely used that it would be difficult to eliminate them; but one must agree with Hinton that the use of the two terms as subordinal divisions of the Lepidoptera is untenable. It may be advisable, however, to retain the two names for two *series* of Ditrysia: Rhopalocera, the butterflies, and Heterocera, the higher moths. On the basis of priority, however, Rhopalocera and Heterocera are preceded by older names. Some of the usages are as follows:

Rhopalocera	Heterocera
Papiliones Linnaeus, 1758.	Phalaenae Linnaeus, 1758.
Diurni Latreille, 1802. Boisduval, 1829.	Nocturni and Sphingides, Latreille, 1802.
Diurna Latreille, 1809. Leach, 1815.	Nocturna and Crepuscularia Latreille, 1809. Leach, 1815.
Rhopalocera Boisduval, 1840.	Nocturni and Crepusculares Boisduval, 1829.
	Heterocera Boisduval, 1840.

A case could be made for the use of Papiliones and Phalaenae or Diurna and Nocturna, but with Rhopalocera and Heterocera so long in common use and spread so extensively in a vast literature, it appears appropriate to continue to use these names.

KEY TO THE SERIES OF DITRYSIA

1. Antennae not apically clavate; hind wings usually with frenulum (higher moths).....**Heterocera**, p. 34.
2. Antennae swollen into an apical club; frenulum absent (butterflies).....**Rhopalocera**, p. 445.

## Series HETEROCERA

*Phalaenae* Linnaeus, 1758:496.

*Nocturni* and *Sphingides* Latreille, 1802:400, 404.

*Nocturnes* Latreille, 1805:142.

*Nocturna* and *Crepuscularia* Latreille, 1809:187, 189, 209, 216. Leach, 1815:130, 131.

*Nocturni* and *Crepusculares* Boisduval, 1829:32, 38.

*Heterocera* Boisduval, 1840:39.

## The Moths

## KEY TO THE SUPERFAMILIES OF HETEROCERA IN HAWAII

1. Wings divided longitudinally into lobes or plumes, part of **Pyraloidea** . . . . . see next volume.  
Wings not divided into plumes . . . . . 2
- 2(1). Hind wing either with all three branches of vein one present, or, if 1c is absent, then often small species with narrow wings and venation reduced, or hind wings with veins 7 and 8 (subcosta) approximate or fused for a considerable distance beyond cell . . . . . 3  
Hind wing with at most only two branches of vein one present, 1c always absent, vein 8 (subcosta) diverging from the cell or from apex of cell or only a short distance beyond apex of cell . . . . . 4
- 3(2). Hind wing with vein 8 completely free from 7 beyond the cell, but never rather large species with chaetosemae, **Microlepidoptera** . . . . . see succeeding volumes.  
Hind wing with vein 8 coincident with 7 for a considerable distance beyond cell or rather large species with chaetosemae, **Pyraloidea** . . . . . see next volume.
- 4(2). Tympanum absent; hind wings with vein 8 separated from 7 and subparallel to it from near base to beyond discocellulars and with a cross-vein connecting the two veins near or before middle of cell; large, heavy-bodied species with comparatively long, narrow fore wings . . . . . **Sphingoidea**, p. 425.  
Tympanum present either in metathorax or base of abdomen; veins 7 and 8 either touching or fused at a point before middle of cell, but strongly diverging from that point and without a cross-vein between them . . . . 5
- 5(4). Tympanum in metathorax . . . . . **Noctuoidea**, p. 197.  
Tympanum in base of abdomen . . . . . **Geometroidea**, p. 36.

## KEY TO THE FAMILIES BASED UPON LARVAE

Comparatively little work has been done on the larvae of Hawaiian Lepidoptera, and this most interesting field of study awaits detailed investigation. What we know about Hawaiian caterpillars is mostly the result of observations by Dr. Swezey. Dr. Swezey also published a key to some of the larvae commonly met with in houses and gardens (1944:138), and this was the only attempt made in Hawaii to assemble details concerning a diverse group of Hawaiian caterpillars in one place.

1. Caterpillars either with a single, large, horn-like process on eighth abdominal tergite, or with a pair of long horn-like processes on thorax and on eighth abdominal tergite, or body with numerous, large, spinose processes (all caterpillars large when full grown).....2  
 Caterpillars never with such processes (caterpillars large or small).....4
- 2(1). With a single horn-like process rising from middle of eighth abdominal tergite.....**Sphingidae**.  
 With more than a single process on dorsum.....3
- 3(2). With a pair of tentacle-like processes arising from dorsum of thorax and another pair from the eighth abdominal tergite.....**Danaidae**.  
 Body with rows of many large spinose processes; very spiny caterpillars.....**Nymphalidae**.
- 4(1). Body with numerous, usually dense, secondary setae, specialized setae or hairs.....5  
 Body with primary setae only, and usually appearing mostly rather bare; although some of the setae may be long, they are never dense.....6
- 5(4). Caterpillar subcylindrical and worm-like; crochets of prolegs forming a continuous row.....**Pieridae**.  
 Caterpillar more or less slug-like, subfusiform; crochets of prolegs interrupted by a fleshy lobe which projects from the sole of the proleg.....**Lycaenidae**.
- 6(4). With only a single pair of prolegs, and these on the sixth abdominal segment.....**Geometridae**.  
 With more than one pair of abdominal prolegs.....7
- 7(6). The group of setae just in front of the prothoracic spiracle consisting of only two setae.....8  
 This setal group containing three setae..**Microlepidoptera** (to be considered in later volumes).

- 8(7). On abdominal segments bearing prolegs there is a seta ("IV") behind the spiracle and another seta ("V") beneath the spiracle; crochets of prolegs forming a line. . . . . **Noctuidae.**  
 Proleg bearing abdominal segments with the two setae IV and V both placed below the spiracle; crochets of prolegs forming a ring (sometimes not completely closed). . . . . **Pyralidae.**

### Superfamily GEOMETROIDEA Forbes, 1923:41

*Phalaenides* Leach, 1815:134.

*Notodontina* Herrich-Schaeffer, 1855:84.

### Family GEOMETRIDAE Stephens, 1829:114

*Geometrae* Linnaeus, 1758:496, 519.

*Phalaenites* Latreille, 1805:208; 1809:226.

*Phalaenida* Leach, 1815:134. Boisduval, 1833:114.

*Phalaenidae* Samouelle, 1819:252.

*Geometrae* Boisduval, 1840:177.

*Selidosemidae* Meyrick, 1892:53.

Franclemont, 1952:309, 311. Notes on the use of the family name.

The Geometridae come next in endemic development to the larger group Noctuidae in the Hawaiian macrolepidopterous fauna, and these two families are the only families of the Macrolepidoptera to have any significant development in Hawaii.

The "looper" or "measuring worm" caterpillars of this family are known to the native Hawaiians as "peelua kuapuu."

For comments on the pupae of Geometridae, see Mosher, 1916:125, 126.

Only two of the subfamilies of the Geometridae have representatives in Hawaii, and these may be distinguished as follows:

#### KEY TO THE SUBFAMILIES OF GEOMETRIDAE IN HAWAII

1. Hind wings with vein five absent or very faintly indicated; fore wings without areoles, or with one areole in *Tritocleis* only. . . . . **Ennominae**, p. 36.
2. Hind wings with vein five strongly developed; fore wings each with two well-developed areoles. . . **Larentiinae**, p. 150.

#### Subfamily ENNOMINAE Duponchel, 1844

*Boarmiinae* Duponchel, 1844.

*Urapteryginae* Hampson, 1918:384.

## KEY TO THE GENERA OF ENNOMINAE IN HAWAII

1. Face with flat, closely appressed scales.....**Anacamptodes**, p. 38.  
     Face with erect scales and/or hairs.....2
- 2(1). Face with scales erect and shaggy, comparatively sparse  
     (not dense and not compacted into a cone-shaped  
     mass); palpi with about basal half largely hidden be-  
     tween eyes; fore wing with a well-defined areole.....**Tritocleis**, p. 148.  
     Face with dense scales and/or hairs, often partly com-  
     pacted into a forward-projecting, somewhat cone-  
     shaped mass (as seen from side); palpi with basal half  
     broadly exposed; fore wing without an areole.....3
- 3(2). Palpi conspicuously exposed to view when specimen is  
     viewed from directly above; fore wings not or, at most,  
     only slightly falcate.....**Scotorythra**, p. 42.  
     Palpi so short that when specimen is viewed from di-  
     rectly above the palpi are hidden from view by the  
     dense mat of erect hair on face (or at most only the  
     extreme tip of palpi distinguishable); fore wings  
     strongly falcate in both sexes; large forms about 50  
     to more than 80 mm. in expanse.....  
     .....**Scotorythra** subgenus **Aerodrepanis**, p. 142.

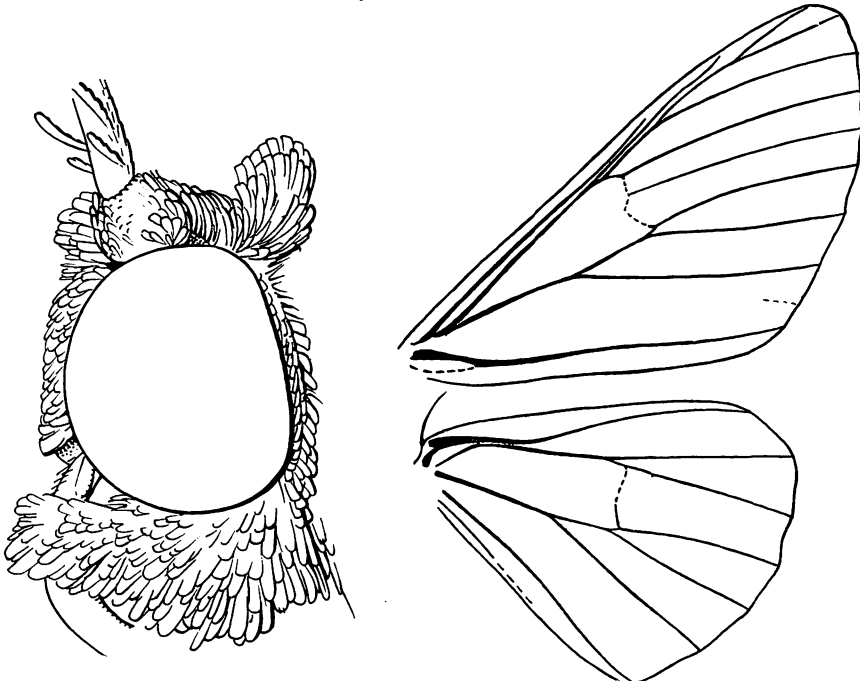


Figure 12—Head (left) and wing venation (right) of *Anacamptodes fragilaria* (Grossbeck).

Genus **ANACAMPTODES** McDunnough, 1920

This is a North American genus.

**Anacamptodes fragilaria** (Grossbeck) (figs. 12, 13, 14, 15).

*Cleora fragilaria* (Grossbeck), 1909:194.

*Anacamptodes fragilaria* (Grossbeck) McDunnough, 1920:29, pl. 5, fig. 10.

"*Stegania* species," as a misidentification in some Hawaiian literature.

Kauai, Niihau, Oahu, Molokai, Maui, Hawaii.

Immigrant; a native of southern California. First found in Hawaii in light traps set at Pearl Harbor in 1944.

Hostplants: *Acacia farnesiana* ("klu"), *Amaranthus*, *Antigonon leptopus* (Mexican creeper), *Bauhinia monandra* (St. Thomas tree), *Calliandra haematoma* ("lehua haole"), *Cassia grandis* (pink shower), *Cassia javanica* X *Cassia fistula* (rainbow shower), *Cordia subcordata* ("kou"), *Desmanthus virgatus*, *Hibiscus*, *Ipomoea tuberosa*, *Justicia betonica* (flowering herb), *Leucaena glauca* ("koa haole"), *Litchi chinensis*, *Macadamia ternifolia*, *Malvastrum tricuspidatum* (false mallow), mint, *Momordica balsamina* (balsam apple), *Nicotiana glauca* (tree tobacco), *Ocimum basilicum* (basil), orange, *Passiflora foetida*, *Pithecolobium dulce* ("opi-uma"), *Poinciana regia*, *Portulaca oleracea* (purslane), *Prosopis chilensis* ("kiawe"; a favored hostplant), *Psidium cattleianum* (strawberry guava), rose, *Samanea saman* (monkey pod), *Santalum album* (sandalwood), *Schinus molle* (pepper tree), *Schinus terebinthifolius* (Christmas berry), *Sida*, soybean, *Spathodes campanulata* (African tulip), *Tectona grandis* (teak), *Terminalia catappa* (false "kamani"), turnip.

Parasites: *Apanteles praesens* Muesebeck (introduced by Krauss from California especially to attack the larvae of this moth), *Ephialtes hawaiiensis* (Cameron). In California, the ichneumons *Campoplegidea flavescens* Wiley and a species of *Phobocampe* also are parasites.

Predators: *Eumenes latreillei petiolaris* (Schultz), *Eumenes pyriformis philippinensis* Bequaert (usually stores six to eight larvae per cell of nest), *Oechalia pacifica* (Stål).

The attacks of the larvae upon the important cattle forage crop *Prosopis* (mesquite, kiawe, algaroba) caused considerable concern to ranchers soon after this moth was discovered here, because many trees were badly defoliated. The *Eumenes* wasps, which were accidentally introduced at about the time of the appearance of the moth, however, have done a good job of keeping the caterpillars under control, and even when it is difficult for one to find caterpillars feeding on the *Prosopis*, they may be found by breaking open the mud nests of the *Eumenes*.

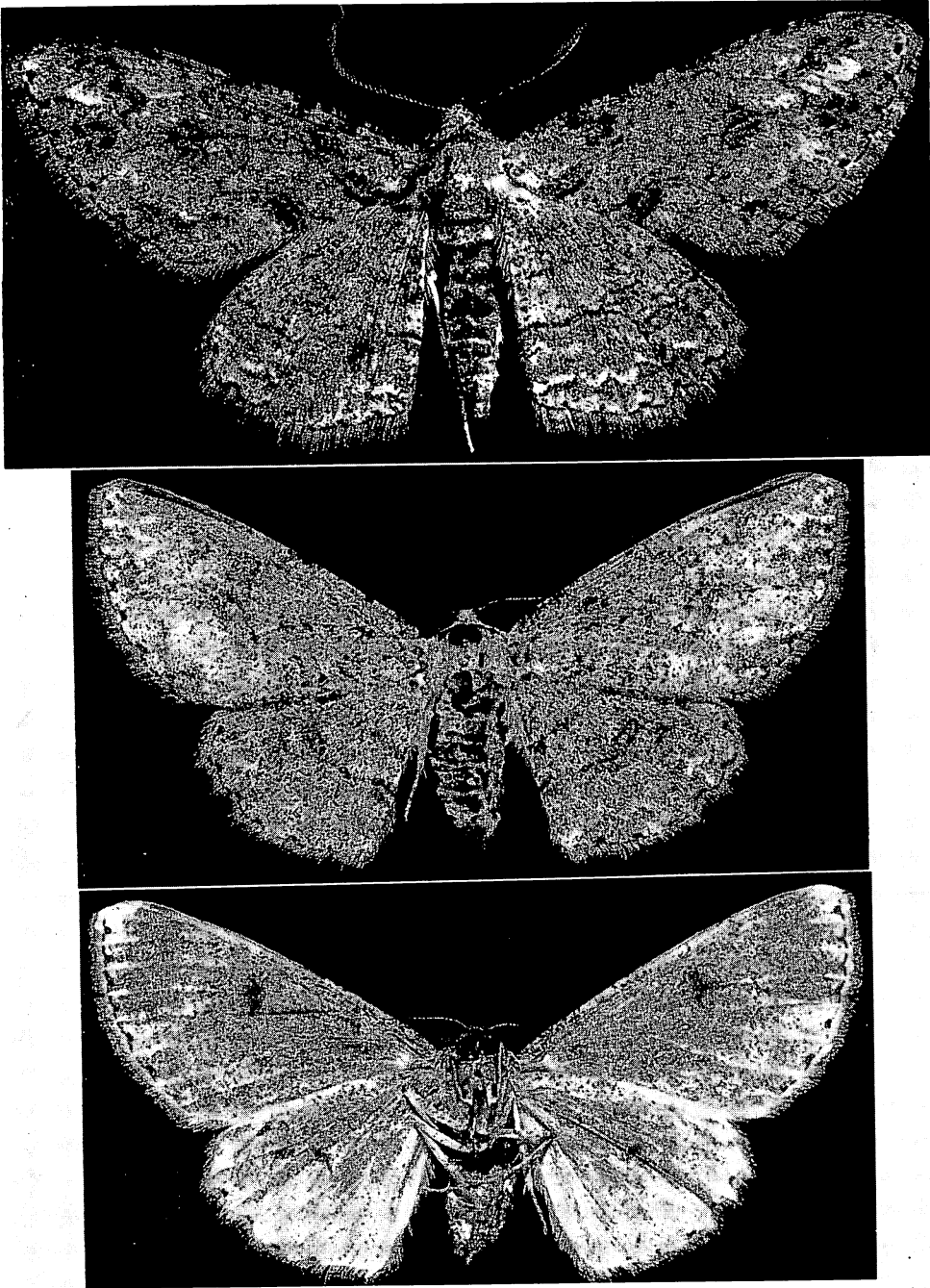


Figure 13—*Anacamptodes fragilaria* (Grossbeck). Above: Male. Below: Upper and lower sides of female. Oahu. Not to same scale. Size range of 35 examples, kindly measured by C. E. Pemberton, 27 to 40 mm. in expanse.

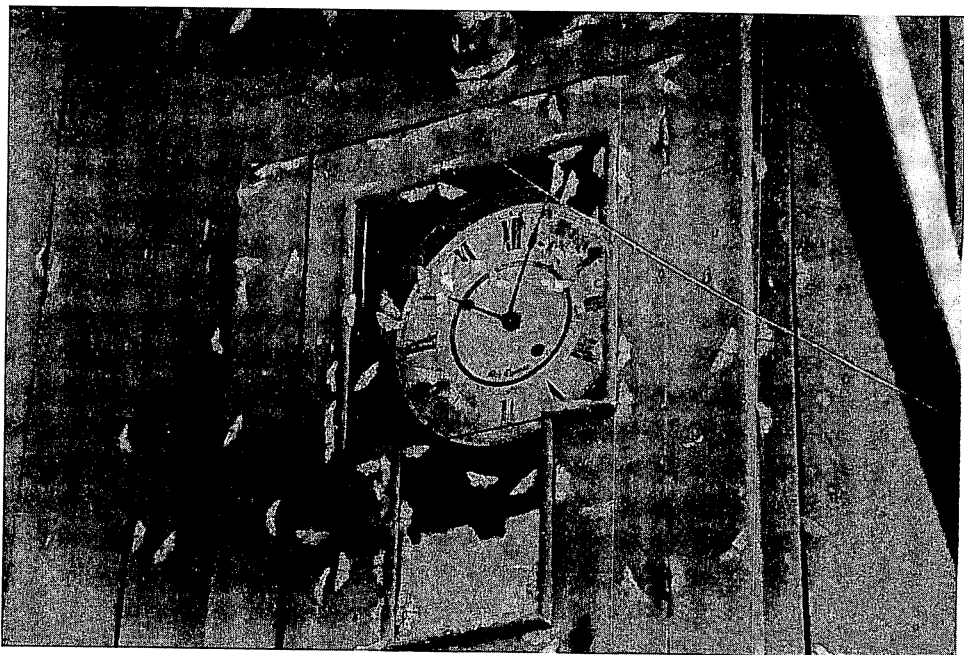


Figure 14—*Anacamptodes fragilaria* (Grossbeck) gathered about an illuminated clock. Below: Defoliation of *Leucaena glauca* by caterpillars of this species.



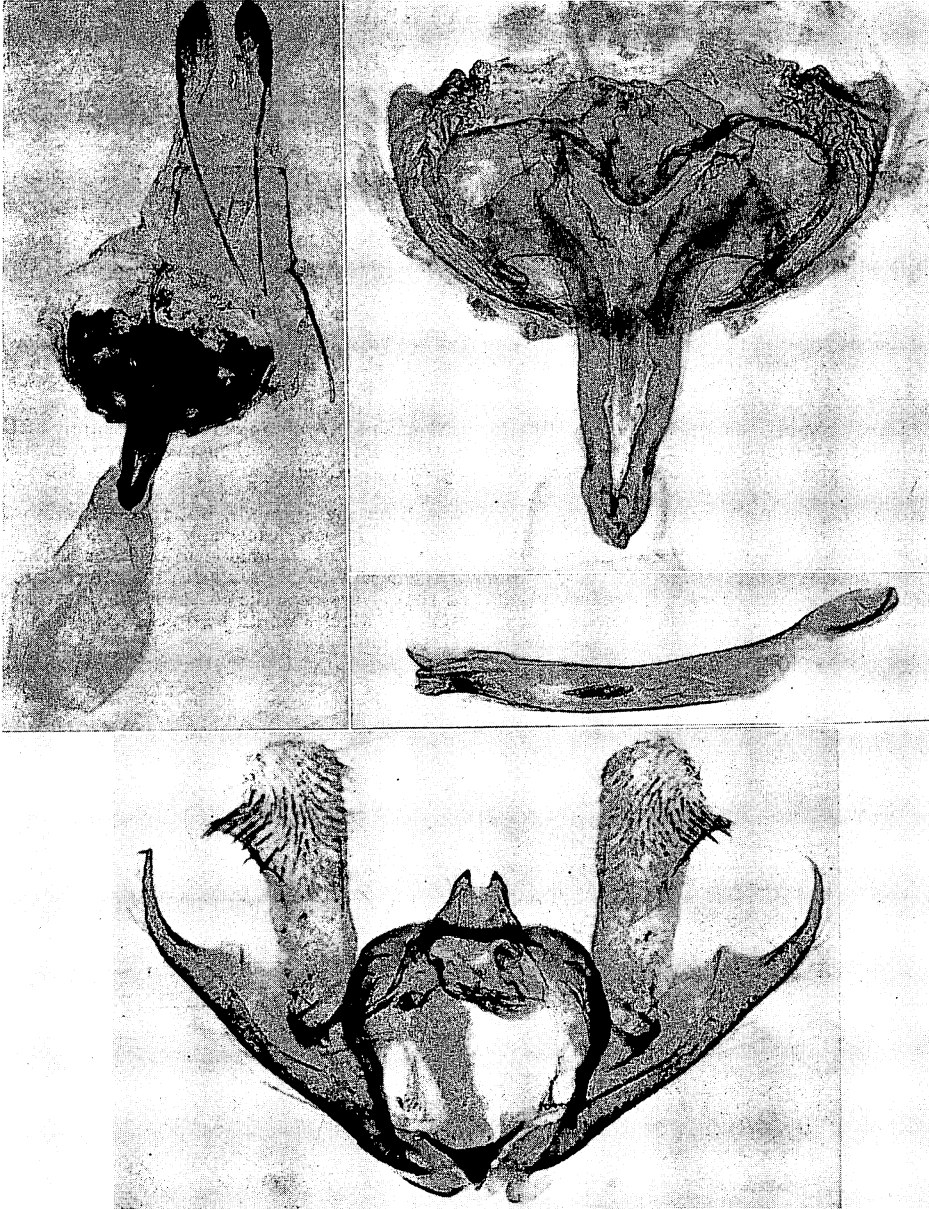


Figure 15—Genitalia of *Anacamptodes fragilaria* (Grossbeck). Upper two figures, female; middle figure, aedeagus; lower figure, male.

Genus **SCOTORYTHRA** Butler

*Scotorythra* Butler, 1883:177; type: *arboricolans* Butler.

*Sisyrophyta* Meyrick, 1899:168; type: *gomphias* Meyrick. **New synonym.**

*Nesochlide* Perkins, 1901:216; type: *epixantha* Perkins. **New synonym.**

*Scotorythra* is one of the characteristic endemic products of Hawaii. It appears possible that it may be related to the Indo-Pacific *Cleora* and *Carecmotis*, although its exact affinities remain undetermined. The moths are among the most common of all Hawaiian moths, and the looper caterpillars are frequently met with on many plants.

In open spaces in the forests at nightfall one may see large numbers of the moths flying slowly overhead and often out of reach, traversing these spaces and all or nearly all travelling in the same direction. Sometimes they congregate in hundreds within some hollow tree-trunk or amongst the pendant masses of dead fronds of tree-ferns. In some cases all the individuals so congregating are males, even in one case where several hundreds of examples were taken together. Many of the species are attracted by light, in some of these the males and in others the females are much more numerous. Thus but one female of *Nesochlide epixantha* was attracted amongst scores of the other sex. . . .

No doubt, formerly, numerous species have existed on the lowlands, but these have mostly disappeared owing to the attacks of foreign predaceous insects, especially ants. In very dry localities, where that destructive little ant *Pheidole megacephala* is unable to exist, or is hardly present, species of *Scotorythra* still flourish. This is the case with *S. paratactis*, the caterpillars of which are very numerous on the scanty vegetation that grows near the coast on the driest parts of the west side of Oahu. The exposed caterpillars of this species would be quickly exterminated by *Pheidole* in most parts of the coastal region of this island.

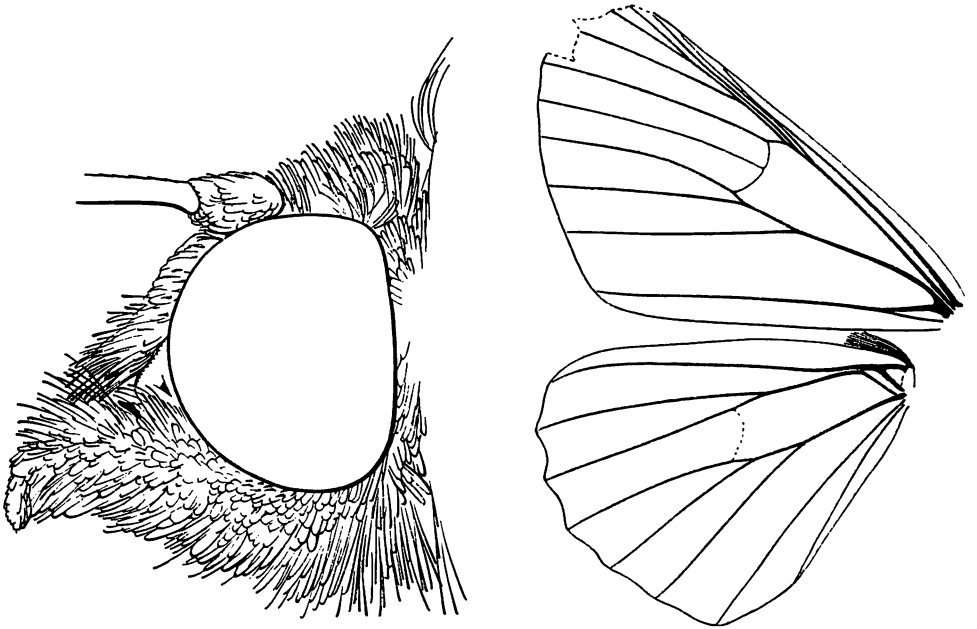


Figure 16—Head (left) and wing venation (right) (female) of *Scotorythra arboricolans* Butler, the type of the genus.

The caterpillars of some of the species of *Scotorythra* appear to be nocturnal in their feeding habits, and during the daytime hide beneath the bark of the trunks of the trees, on whose foliage they feed. In this situation considerable numbers may be found at rest, ranged side by side. They form a most important part of the food supply of the endemic birds, and are supplied by the parents to the young of nearly all the species, while they are a favourite food of many adult birds as well. On the other hand they are very little attacked by the many species of wasps of the genus *Odynerus*, and it is most remarkable that, since these do occasionally store them up in their cells as food for their young, they should not more often avail themselves of so abundant a prey, when more favourite caterpillars become scarce or fail. The ubiquitous bug, *Oechalia grisea* [probably includes more than this one species, E. C. Z.], also destroys great numbers of the larvae of many *Scotorythra*. The variation in colour and markings of many of the species of *Scotorythra* (as well as of *Neoschlida* and *Acrodrepanis*) is very great. . . . In most species, that show much variation, the extreme varieties are taken in company. It is not known whether difference in the food plant is to any extent the cause of variation, but it is certain that it is not so in some cases, where variation is very great, as several species have been tested in this respect. It is very noticeable how frequently species, that are quite distinct, yield similar varieties, and a character which appears as a variation in one or more species may be a constant character in another. As an example of this one may mention the presence, as a constant character, or merely as an infrequent variation, of a conspicuous pale costal streak. In some species the males and in others the females appear to be more subject to variation, and some, of which large numbers have been examined, exhibit very little variability.

The pupae of *Scotorythra* are very commonly found when one is searching for other insects, under wet moss, in damp rotten wood, under logs, and in other situations. Most of them, however, as well as the caterpillars, are difficult to breed, when removed from the wet mountain forests to the lowlands, even though great pains are taken to keep them as nearly as possible under natural conditions. Some of the large species have been observed laying their eggs in the bark of trees, the ovipositor being of great length when fully protruded. (Perkins, 1913: cl-cli.)

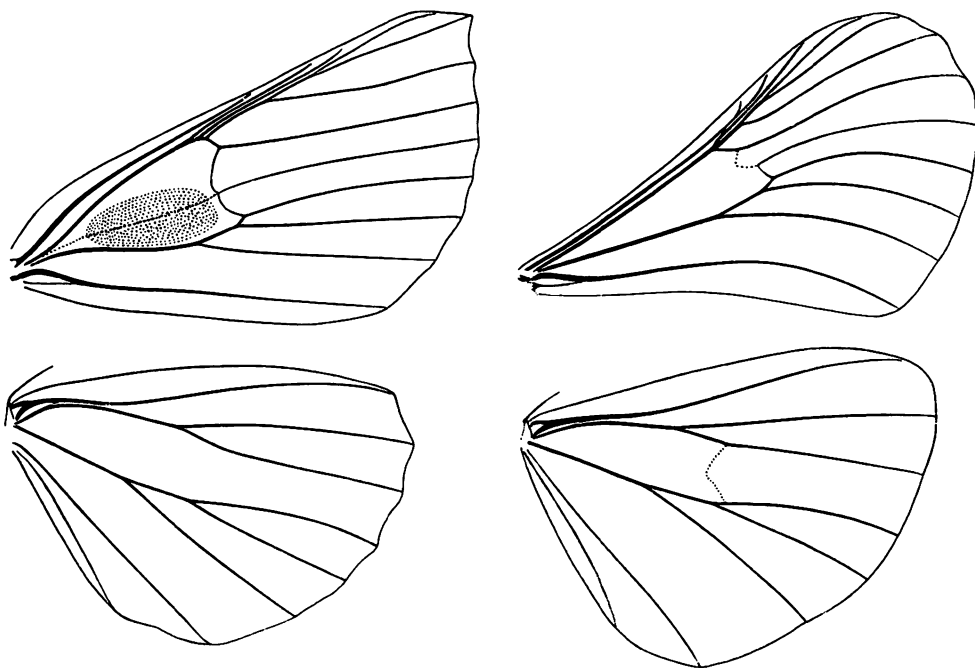


Figure 17—Wing venation of *Scotorythra epixantha* (Perkins), male (left), and of *Scotorythra gomphias* (Meyrick), male (right).

Perkins (same reference: cl-cli) also noted that

The forms included in *Scotorythra* itself are of varied structure, as if tending to break up into several groups or genera, and these distinctions in the adult appears to be to some extent correlated with corresponding differences in larval characters. The smaller species of the genus, belonging to the group of *S. corticea*, for instance, have a characteristic appearance and pattern (or form of the second line of the fore wings), tending at the same time to differ in character of neurulation, and also in the length of the tibial spurs from the others. Some of them, and perhaps all, rest at times with spread wings, *Boarmia*-like, on the trunks of trees. On the other hand the numerous species, large and small, of the *S. rara* group, rest *Anisopteryx*-like, with the wings unspread, so as to form an elongate triangle, creeping into holes in trees or beneath bark, or lying hidden amongst masses of dead fern leaves during the daytime.

I have reduced the generic names *Nesochlide* and *Sisyrophyta* to synonymy, because, although their types are remarkable species, I have been unable to find any characters other than the secondary sexual features of the male to separate them from *Scotorythra*. Their females are similar to female *Scotorythra*. When one examines such extreme forms as the males of *Sisyrophyta*, and an average *Scotorythra*, it may appear that my action is unjustified lumping. But after further study and the tracing of the development of the divergent tendency illustrated by *Scotorythra trachyopsis*, and the seemingly incorrect action in erecting genera based upon the characters of one sex only, my course will appear more reasonable.

This genus of 36 described forms, the largest of the Hawaiian Geometridae, is in a most unsatisfactory taxonomic condition. The variation in color and pattern, and in some forms also in size, is extraordinary and confusing in the extreme. Meyrick made a key to the 30 species recognized by him in 1899, but his key is of little use. I have tried to make a new key, but I have failed to find external characters which are stable enough to use as good key characters. I believe that it is by no means certain that males and females have been correctly associated in many instances. Also, there may be a considerable amount of mixing of species in some of the series under various names. I have, therefore, come to the regrettable conclusion that the data at hand are inadequate for the preparation of a workable key and arrangement of the species. Some of the problems can be resolved only by breeding experiments. Others can be clarified only by extensive study of the genitalia of many specimens. If a complete set of correctly matched males and females were available, the task of preparing a key would be aided greatly; but only one sex is known for a number of the species.

It seems to me that individuals of certain species from different localities and perhaps different broods have a distinct appearance because of size, color and pattern. Some long series caught at the same times and places are fairly constant, yet specimens caught at different times and places are distinct-appearing.

Meyrick (1899:135) stated that "The climax of difficulty is reached in *Scotorythra*, where many of the species are also very variable, whilst the sexes often differ considerably and are hard to match, and the secondary sexual characters, which often afford a good distinction in the males, are not available in the females."

I believe that a number of errors in identification exist in the *Scotorythra* which Perkins listed as occurring on Mt. Tantalus, Oahu (*Proc. Hawaiian Ent. Soc.* 1:41, 1906).

## PROVISIONAL KEY TO THE MALE SCOTORYTHRA

The following species are not included in this key because they are known only from female specimens: *anagraptis*, *crocorrhoa*, *epicyma* and *platycapna*.

It should be possible to strengthen this key greatly by studying a more adequate series of specimens. I could not use certain features which may offer excellent specific characters because of inadequate material before me at the time I wrote the key.

1. Under side of fore wing with either a large, peculiar, ovate patch or mat of modified dense scales occupying most of the cell or with the edges of the termen of the fore wings strongly curled under and most of under side of fore wings clothed with very dense, erect hairs. . . . . 2  
Under side of fore wing normal, without such specialized structures. . . . . 5
- 2(1). Under sides of fore wings mostly clothed with very dense, erect hair. . . . . 3  
Under sides of fore wings without such erect hair, but with a peculiar ovate mat of modified scales confined to the cell. . . . . 4
- 3(2). Upper side of hind wing with a long, medial line of very long, strongly erect hair conspicuous to the unaided eyes, background scaling in that area darker and coarser than remainder of wing, termen strongly crimped under; under side of fore wing with specialized vestiture denser in posterior part of wing. . . . . **ochetias** (Meyrick).  
Upper side of hind wing with the long hairs prostrate or nearly so and not as described above, termen not crimped under; under side of fore wing with specialized vestiture denser in anterior part of wing. . . . . **gomphias** (Meyrick).
- 4(2). Fore wings basically largely yellow or orange, hind wings nearly white in comparison; hind edge of modified cell patch on under side of fore wings with large, broad, ribbon-like scales overlapping it from behind. . . . . **epixantha** Perkins.  
Fore wings largely brown, hind wings mostly dark; modified cell patch on under side of fore wings without such scales along its hind edge. . . **trachyopis** Meyrick.
- 5(1). Fore wings with very edge of inner (hind) margin narrowly yellow or white, this color forming a narrow, line-like margin to the wing; genital valves unusually broad, and genitalia as in figure. . . **artemidora** Meyrick.  
Not so; valves never so broad. . . . . 6

- 6(5). Inner margins of valves concave from base to apex, the entire valve arcuate, as in figures of *apicalis*, *arboricolans*, *corticea* and *caryopsis*.....7  
 Inner margins of valves convex, or at least in part convex, never as in the figures mentioned above.....10
- 7(6). Valves slender, tapering, pointed at apex; harpes comparatively short and directed across valves; uncus with a rather unusual development of large spines, as in figure.....**apicalis** Swezey.  
 Valves comparatively broad, rounded at apex; harpes very long, slender, sinuous, directed along length of valve, as in figures of *arboricolans*, *corticea* and *caryopsis*.....8
- 8(7). Hind wings with termen slightly and shallowly concave just before inner margin of wing, as in figure.....  
 .....**arboricolans** Butler.  
 Hind wings with termen rounded into inner margin, and although the wing margin may be crenulated, it is never shaped as in *arboricolans*.....9
- 9(8). The series of dots marking the distal edge of medial band on fore wing about one-third length of wing from termen at its closest point.....**corticea** (Butler).  
 This series of dots only about one-fifth length of wing from termen.....**caryopsis** Meyrick.
- 10(6). Harpes very long, always much longer than one-half the length of chord of base of valve, as in figures of *hyparcha*, *euryphaea*, *paratactis* and *trapezias*.....11  
 Harpes much shorter, always shorter than one-half the length of the chord of base of valve, often short and broad.....14
- 11(10). Harpe divided into two apical prongs, as in figure 97  
 .....**trapezias** Meyrick.  
 Harpe not forked.....12
- 12(11). Valves subacutely pointed at apex, as in figure 58....  
 .....**euryphaea** Meyrick.  
 Valves rounded apically.....13
- 13(12). Harpes slender and reaching across valves to dorsal margin of valves.....**hyparcha** Meyrick.  
 Harpes heavy and broad, their apices far removed from dorsal margins of valves.....**paratactis** Meyrick.
- 14(10). Body very long, length from front part of head (but excluding palpi) to apex of caudal abdominal hairs, distinctly longer than a fore wing (such as 23:19)..  
 .....**macrosoma** Meyrick.

- Length of body never distinctly longer than fore wing, subequal in length to fore wing in some species but usually distinctly shorter than length of fore wing in most species. . . . . 15
- 15(14). Hind tarsi only one-half the length of a tibia, or only slightly more than one-half as long, never as much as three-fourths as long. . . . . 16  
Hind tarsi three-fourths as long as tibia or longer. . . . . 18
- 16(15). Antemedial and postmedial lines of fore wings continuous, well-marked pale lines (outlined on inner edge of postmedial and outer edge of antemedial line with dark scales). . . . . **diceraunia** Meyrick.  
Antemedial and postmedial lines of fore wings marked only by small, isolated dark dots, or a narrow dark line or small isolated pale spots. . . . . 17
- 17(16). Expanse 40 mm. or more; costa of fore wings concolorous with remainder of wing, not pale. . . . .  
. . . . . **brunnea** (Warren).  
Expanse less than 35 mm.; costa of fore wings narrowly edged with pale yellowish scales to beyond middle on unique type. . . . . **leptias** Meyrick.
- 18(15). Shaft of antenna boldly marked with variable dark bands and some of the pectinations also pale and dark marked. . . . . 19  
Shaft of antenna not spotted or with only pale and indistinct markings. . . . . 25  
NOTE: I have found this to be a weak place in the key, and it may not be satisfactory for some examples.
- 19(18). Length of longest antennal pectinations only one-half as long as greatest diameter of an eye. . **triscia** Meyrick.  
Longest antennal pectinations more than two-thirds as long as greatest diameter of an eye. . . . . 20
- 20(19). Fore wings slightly subfalcate at tips, very prominently marked and banded with brown on a pale yellow background, veins pale and outstanding as in figure 66; Kauai. . . . . **kuschei** Swezey.  
Not such species. . . . . 21
- 21(20). Discal spot in fore wing pale or dark and obscure, not well-marked; dark brown species. . . . . 22  
Discal spot in fore wing dark and well marked. . . . . 23
- 22(21). Discal spot whitish; Kauai, Oahu. **nephelosticta** Meyrick.  
Discal spot obscure, dark; Hawaii. . . . **capnopa** Meyrick.
- 23(21). Harpes short and very broad, as figured. . . . .  
. . . . . **metacrossa** Meyrick.  
Harpes slender and thumb-like. . . . . 24

- 24(23). Antemedial line black with a narrow pale line through its middle; aedeagus as in figure 51... **dissothis** Meyrick.  
Antemedial line without the enclosed pale line; aedeagus as in figure 86..... **pachyspila** Meyrick.
- 25(18). Antemedial line of fore wing nearly straight, at most slightly sinuous, but never strongly convex or strongly angulate.....26  
Antemedial line of fore wing strongly convex or strongly angulate.....27
- 26(25). Pale, mostly yellow species; fore wing with markings almost confined to the narrow antemedial and postmedial lines; under sides of all wings pale yellowish and weakly marked..... **demetrius** Meyrick.  
Dark colored, strongly marked species; under sides of wings gray and brown..... **ortharcha** Meyrick.
- 27(25). Under side of hind wing with postmedial line well defined as a continuous or nearly continuous band, and also usually equally well developed on upper surface...28  
Postmedial line on hind wing, if evident, a series of disconnected dots, never a continuous band.....29
- 28(27). Postmedial line of fore wing sharply multidentate....  
..... **oxyphractis** Meyrick.  
Postmedial line of fore wing sinuous but not sharply dentate..... **goniastis** Meyrick.
- 29(27). Discal spot in fore wing a narrow, pale, dark-edged, sublunate mark..... **hecataea** Meyrick.  
Discal spot in fore wing a dark, rounded blotch.....30
- 30(29). Less than 35 mm. in expanse; fore wings pale brown, aedeagus as in figure 89..... **paludicola** (Butler).  
Over 39 mm. in expanse; fore wings dark brown, aedeagus as in figure 93..... **rara** (Butler).

**Scotorythra anagraptis** Meyrick (figs. 18, 22).

*Scotorythra anagraptis* Meyrick, 1899:178.

Endemic. Kauai (type locality: 4,000 feet).

Hostplant: Unknown.

**Scotorythra apicalis** Swezey (figs. 20, 26, 27).

*Scotorythra apicalis* Swezey, 1948:259.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.



**Scotorythra arboricolans** Butler, type of *Scotorythra* (figs. 16, 18, 19, 20, 21, 23, 24, 25, 104).

*Scotorythra arboricolens* Butler, 1883:177.

*Scotorythra arboricolans* Butler, Meyrick, 1899:173; 1904:350.

*Scotorythra syngonopa* Meyrick, 1899:172, pl. 4, fig. 28; 1904:132. **New synonym.**

*Scotorythra homotrias* Meyrick, 1899:176; 1904:351. **New synonym.**

Endemic. Kauai, Oahu, Molokai, Maui, Lanai (type locality: about 2,000 feet), Hawaii.

Hostplants: *Santalum freycinetianum*, *Santalum paniculatum*, *Santalum pyrrularium*.

Meyrick's series under this name in the *Fauna Hawaiiensis* material are not this species. They have the hind wings continuously rounded in the male. They are close to *corticea*, and if they are not that species they probably represent an undescribed form.

Meyrick's *syngonopa* (type locality: Waimea Mountains, 4,000 feet, Kauai), described from one male, and his *homotrias* (type locality: Olaa, Hawaii), described from one female, are the same as *arboricolans* and are reduced to synonymy. Swezey has reported rearing "*syngonopa*" from *Maba*, *Antidesma platyphyllum* and *Santalum freycinetianum*, but some misidentification is probably involved.

**Scotorythra artemidora** Meyrick (figs. 26, 28, 30).

*Scotorythra artemidora* Meyrick, 1899:186.

Endemic. Hawaii (type locality: Olaa).

Hostplant: Unknown.

**Scotorythra brunnea** (Warren), **new status** (figs. 29, 30, 31, 32, 104).

*Scotorythra rara* aberration *brunnea* Warren, 1896:406.

*Scotorythra brachytarsa* Meyrick, 1899:187, pl. 5, fig. 2. **New synonym.**

Endemic. Kauai, Oahu, Molokai, Maui, Hawaii (type locality: Olaa).

Hostplant: It has been reared from guava, but I have no record of its native hostplants.

It is unfortunate that the well-known name *brachytarsa* must fall into synonymy. Meyrick overlooked Warren's name, and this is the first time that the name has been used in Hawaiian literature. Warren considered this species to be a form of the common *rara*, and he said "Differs from the type-form, in which the ♀♀ are dull fuscous and the ♂♂ blackish, with the stigma, especially in the ♀♀, large and dark, being red-brown or reddish grey-brown in the ♀♀, and slightly darker in the ♂♂; the cell-spot almost obliterated, and all the lines obscure and marked only by dots on the veins." It was described from two females and one male from Olaa (misspelled by Warren as Oloa), Hawaii, which

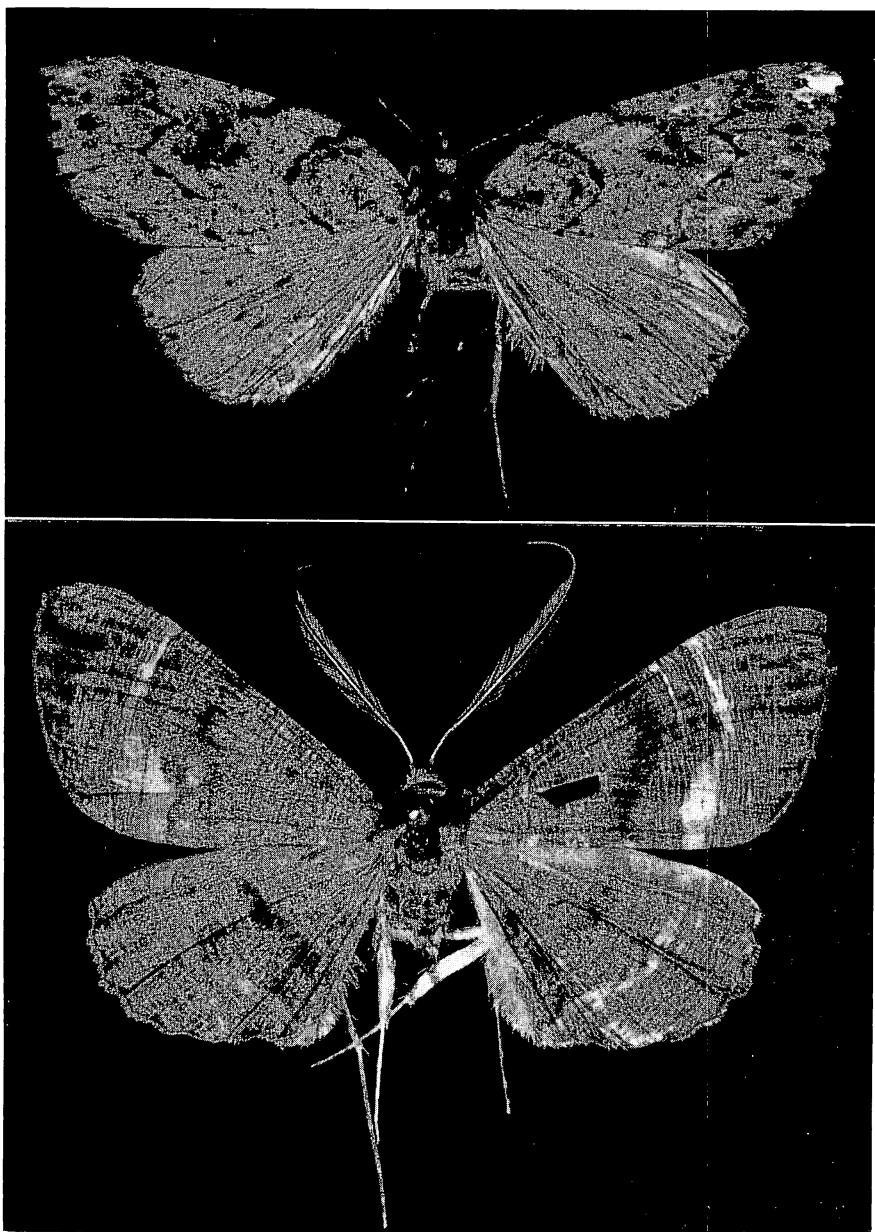


Figure 18—Above: *Scotorythra anagraptis* Meyrick, type female; Kauai, 4,000 feet; expanse, 36 mm. Below: *Scotorythra arboricolans* Butler, type male; "Hawaiian Islds."; expanse 35 mm.; the type of the genus.

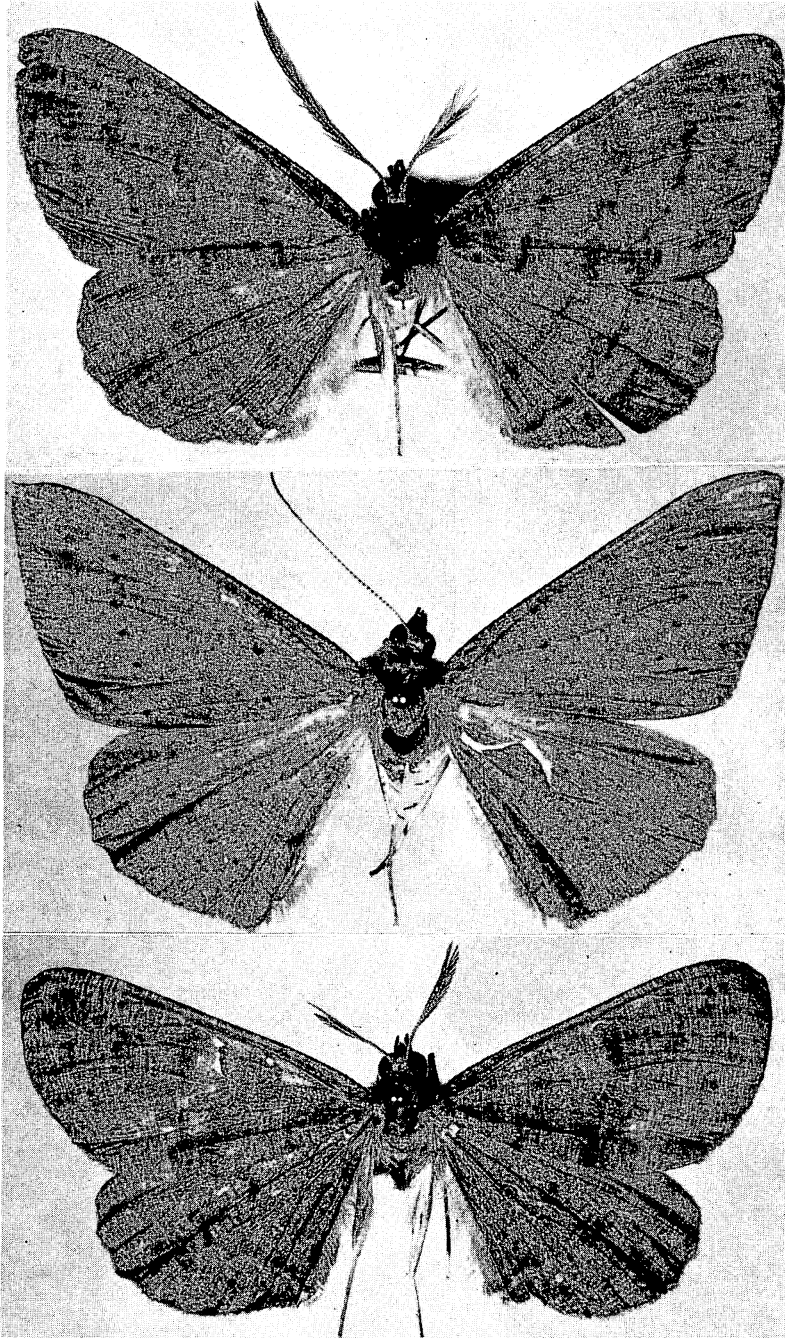


Figure 19—Synonyms of *Scotorythra arboricolans* Butler. Above: A male of *homotrias* Meyrick; northwestern Koolau Mts., Oahu; expanse, 38 mm. Center: the female type of *homotrias* Meyrick; Olaa, Hawaii; expanse, 39 mm. Below: The male type of *syngonopa* Meyrick; Waimea Mts., Kauai, 4,000 feet.

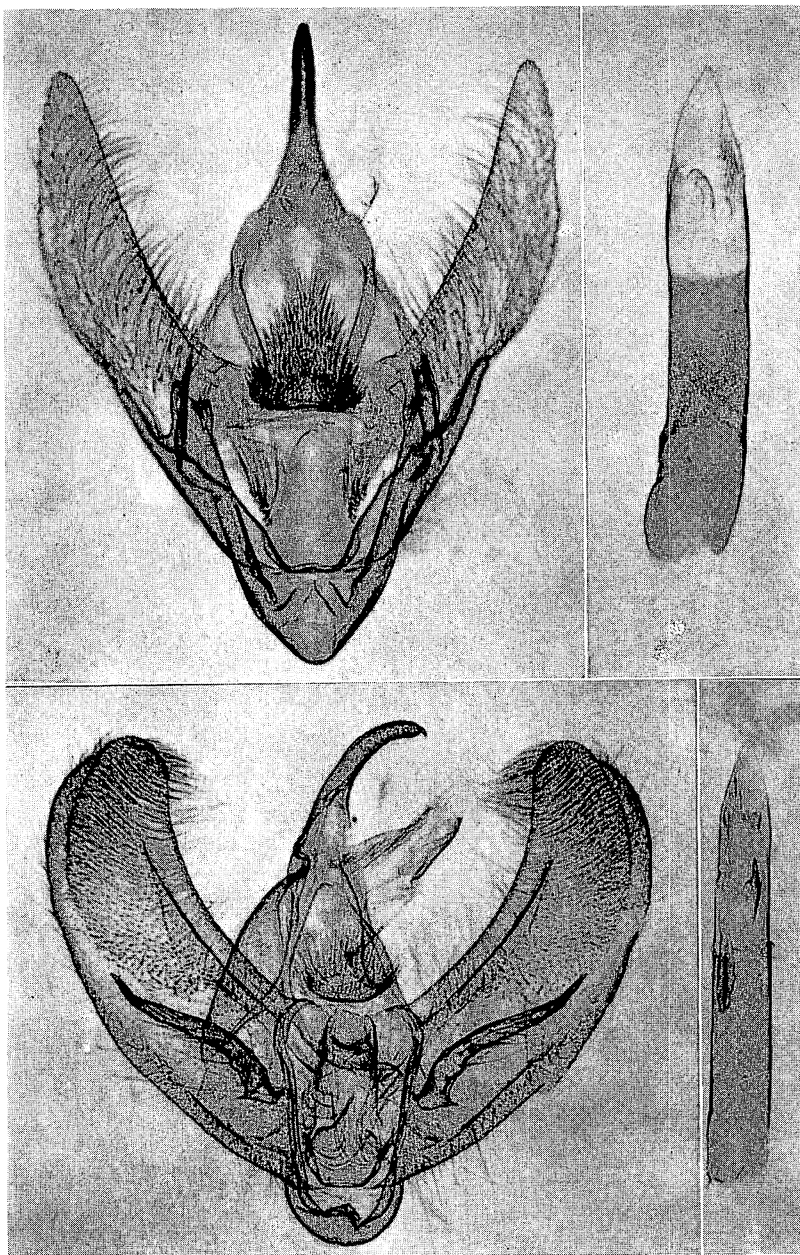


Figure 20—Male genitalia of *Scotorythra apicalis* Swezey, type; Kilauea, Hawaii, above. Of *arboricolans* Butler, type; Lanai; below.



is also the type locality of *brachytarsa*. I examined the type series which has been in the Rothschild collection at Tring, and has now been incorporated into the British Museum collection, and it is one of the forms of what has been recognized as *brachytarsa* since 1899.

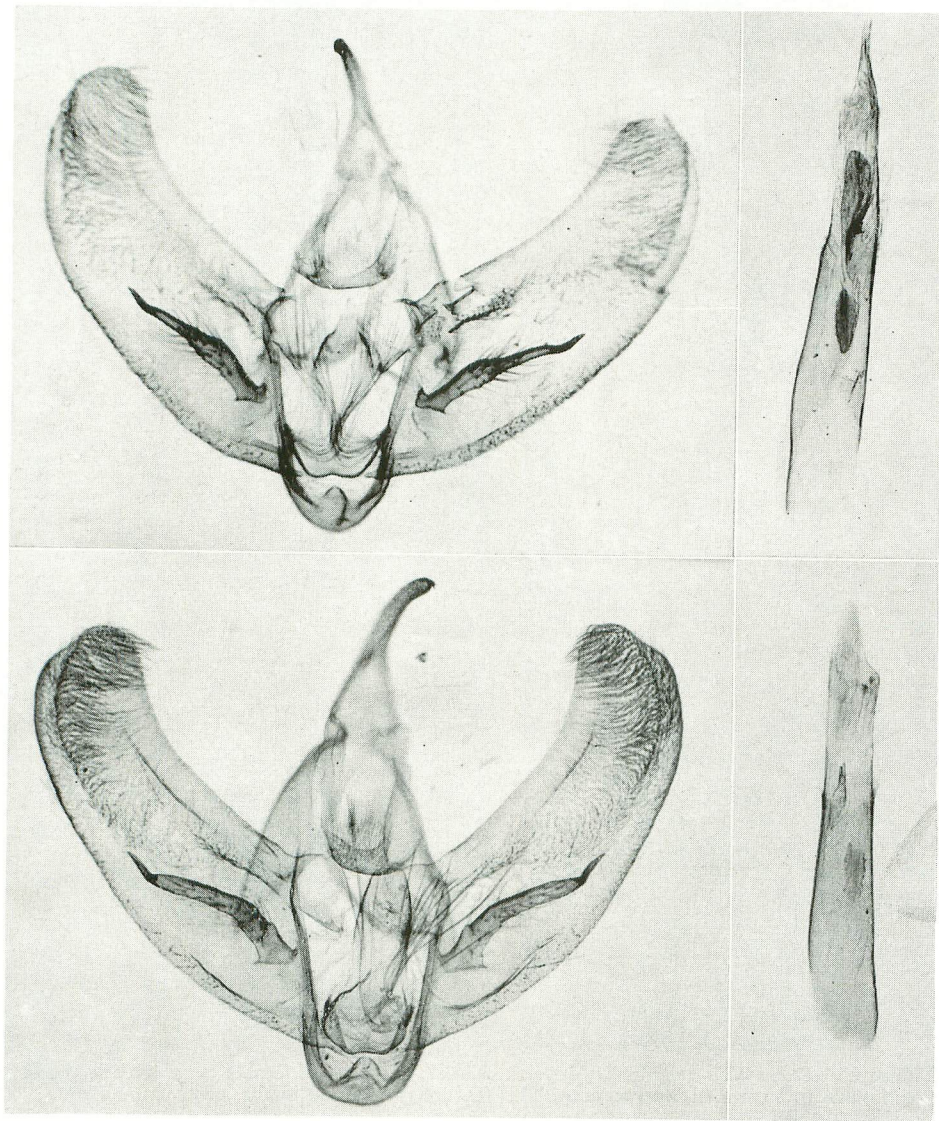


Figure 21—Male genitalia of two synonyms of *Scotorythra arboricolans* Butler. Above: *homotrias* Meyrick; northwestern Koolau Mts., Oahu. Below: *synogonopa* Meyrick, type; Waimea Mts., Kauai.

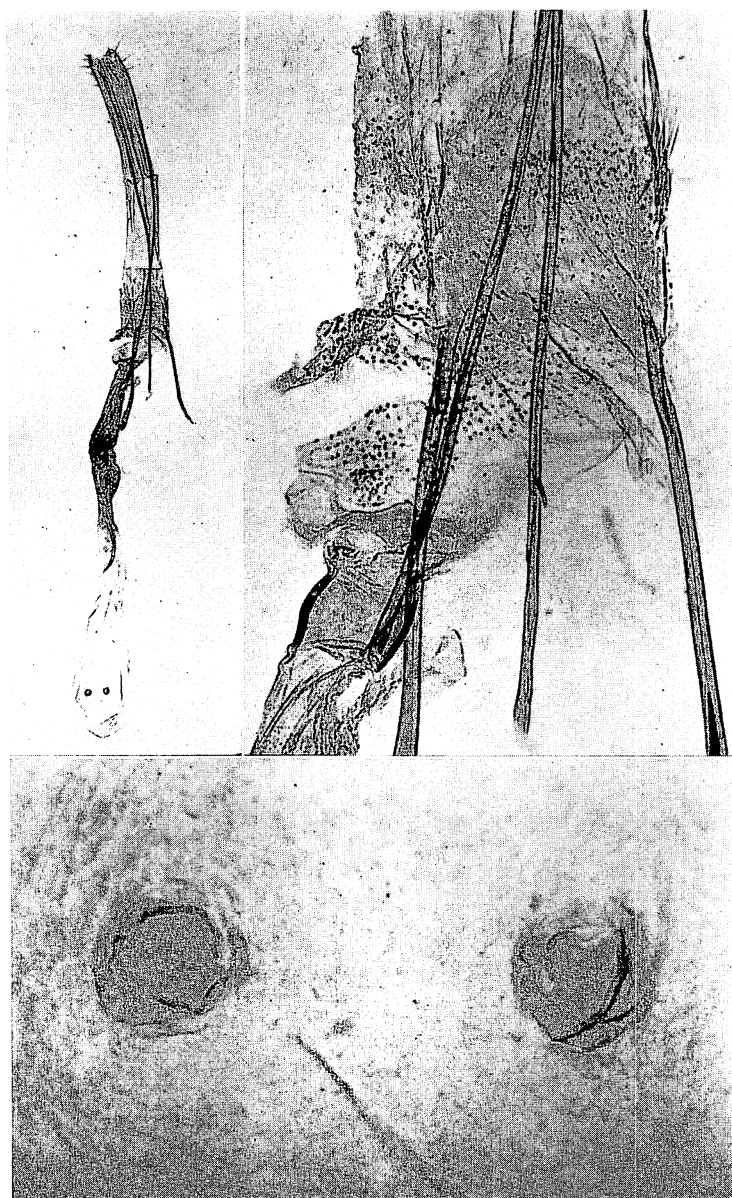


Figure 22—*Scotorythra anagraptis* Meyrick, Kauai; genitalia of female type. This is the only species known to have a divided signum. This feature is enlarged in the lower figure.

**Scotorythra capnopa** Meyrick (figs. 29, 33, 35).

*Scotorythra capnopa* Meyrick, 1899:183.

Endemic. Hawaii (type locality: Olaa).

Hostplant: Unknown.

**Scotorythra caryopis** Meyrick (figs. 34, 35, 36, 37, 105).

*Scotorythra caryopis* Meyrick, 1899:173; 1904:350.

*Scotorythra isopora* Meyrick, 1899:175. **New synonym.**

Endemic. Kauai, Oahu (type locality: Pauoa Valley, Honolulu, 500 feet).

Hostplant: *Acacia koa*.

Parasite: *Apanteles marginiventris* (Cresson).

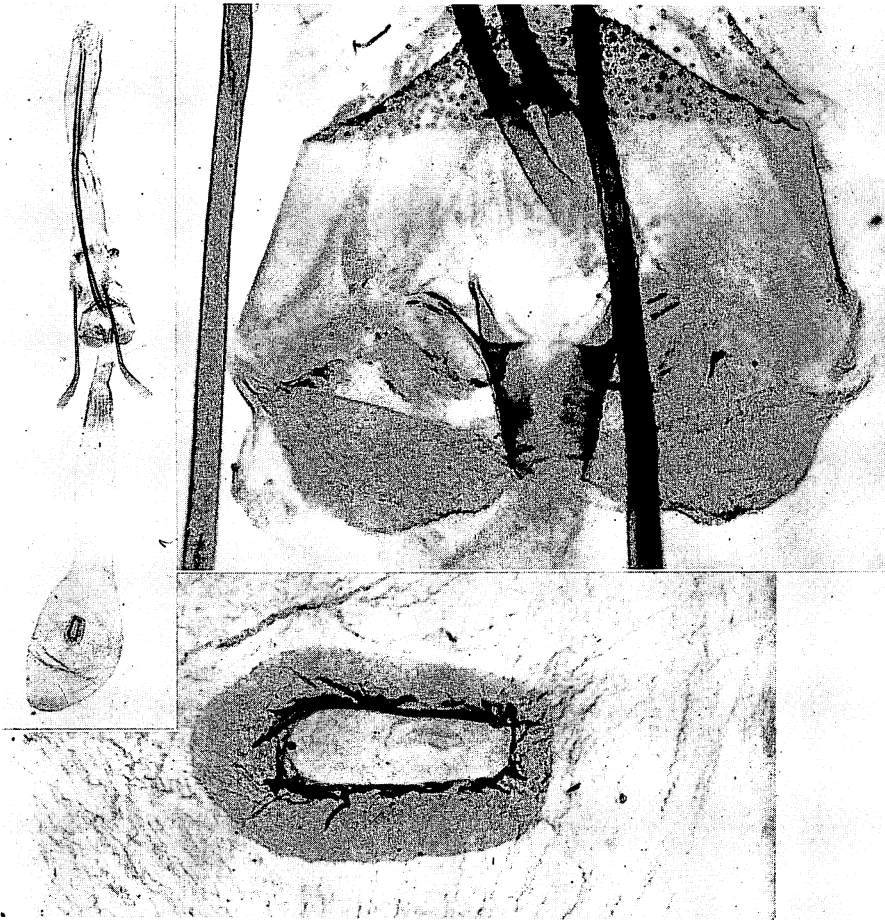


Figure 23—*Scotorythra arboricolans* Butler, West Molokai; female genitalia.



Meyrick's *isopora* must fall as a synonym of this variable species. Meyrick chose more or less extreme forms for the types of his two "species." His *isopora*



Figure 24—Female genitalia of the type of *Scotorythra homotrias* Meyrick; Olaa, Hawaii; a synonym of *arboricolans* Butler. Compare figs. 23 and 25 and note variation in signum.



holotype is a male from the Waimea Mountains, 4,000 feet, Kauai, and it is in good condition with the crenulations along the borders of the hind wings well developed. The holotype of *caryopsis* is a rubbed example not in good condition, and the crenulations of the hind wing do not appear as distinct as they are in the type of *isopora*; other examples in good condition, however, display conspicuous crenulations, and the character is subject to variation.

The caterpillars have been found on Kauai and Oahu and are green with a yellow dorsal line. It is a common species in the koa forests.

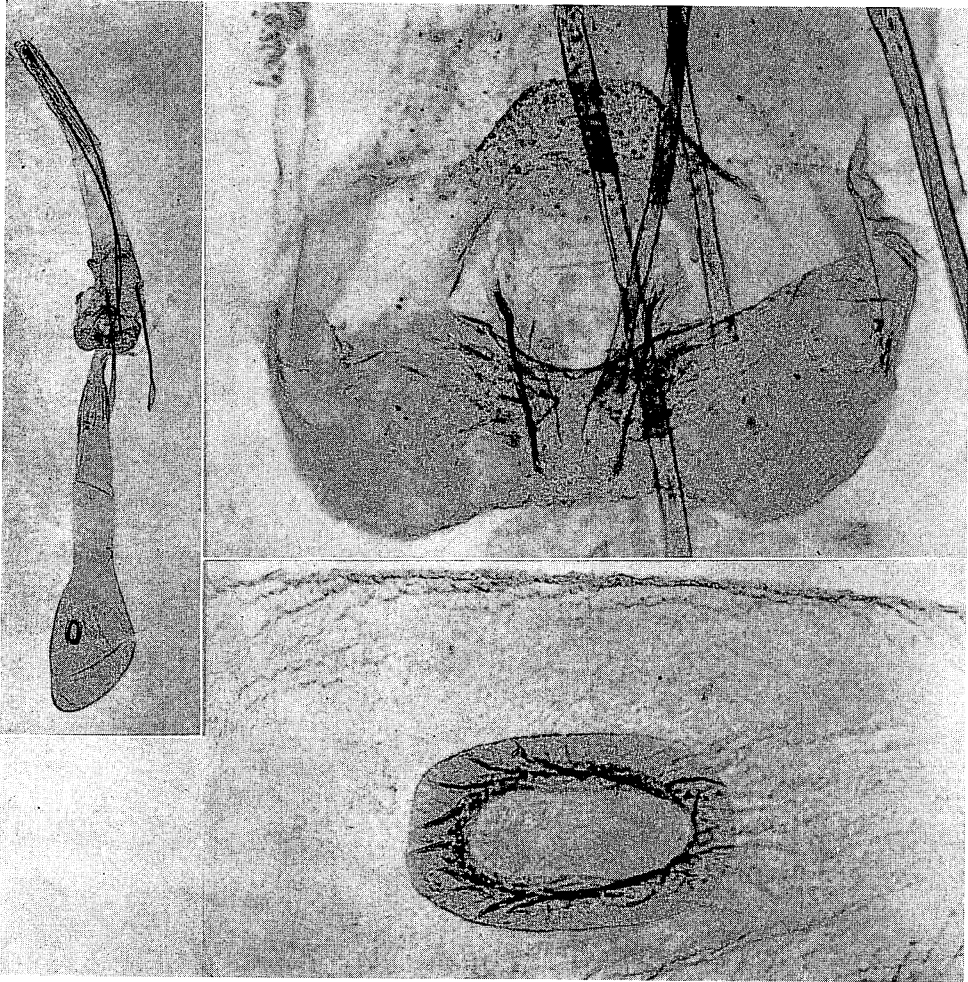


Figure 25—Female genitalia of *Scolorythra syngonopa* Meyrick; West Maui; a synonym of *arboricolans* Butler.

**Scotorythra corticea** (Butler) (figs. 38, 39, 40, 41, 105).

*Scotosia corticea* Butler, 1881:319.

*Scotorythra corticea* (Butler) Butler, 1883:177. Meyrick, 1899:174.

*Scotorythra aruraea* Meyrick, 1899:176, pl. 4, fig. 29. **New synonym.**

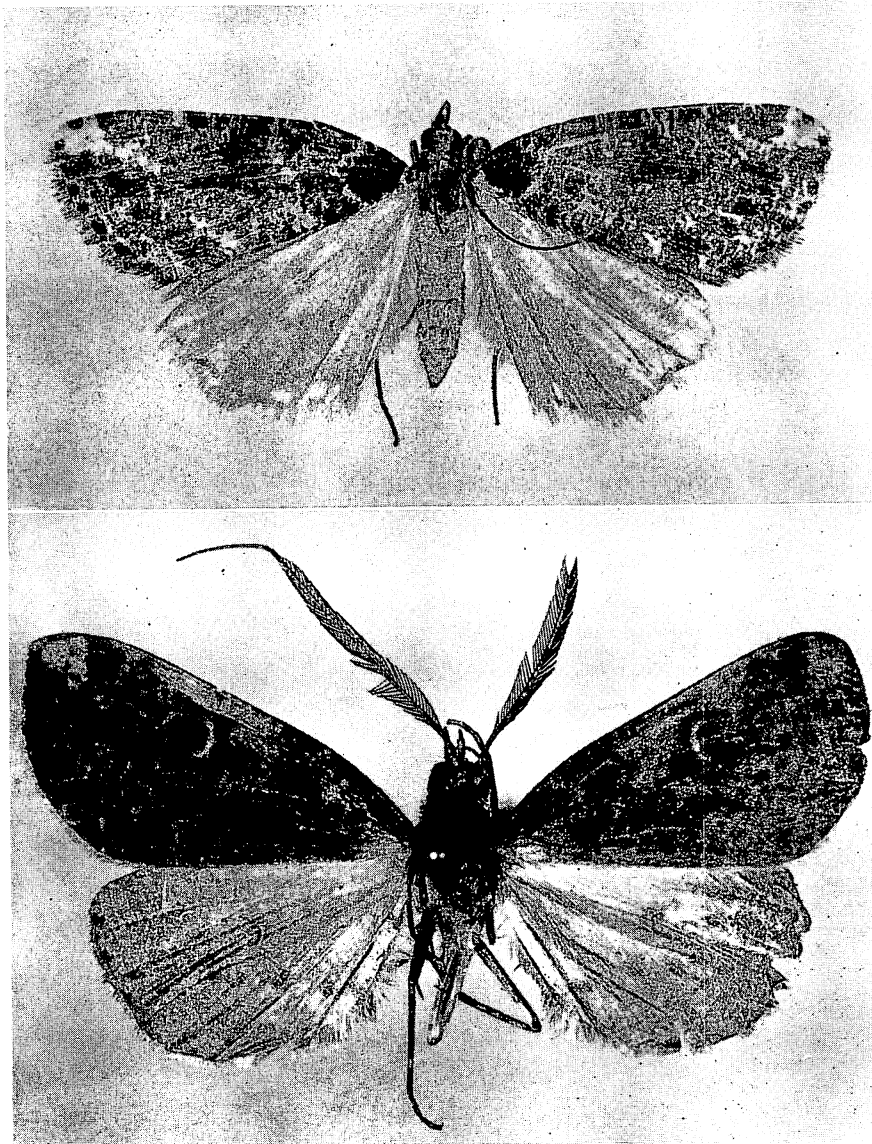


Figure 26—Above: *Scotorythra apicalis* Swezey, type female; Kilauea, Hawaii; expanse, 35 mm. Below: *artemidora* Meyrick, male type; Olaa, Hawaii; expanse, 35 mm. The pale hind margins of the fore wings do not show up well in this photograph.

Endemic. Maui (type locality: Haleakala, about 4,000 feet), Hawaii.

Hostplant: *Acacia koa*.

This is another variable species, and Meyrick's *aruraea* (described from Kilauea, Hawaii), is the same species.

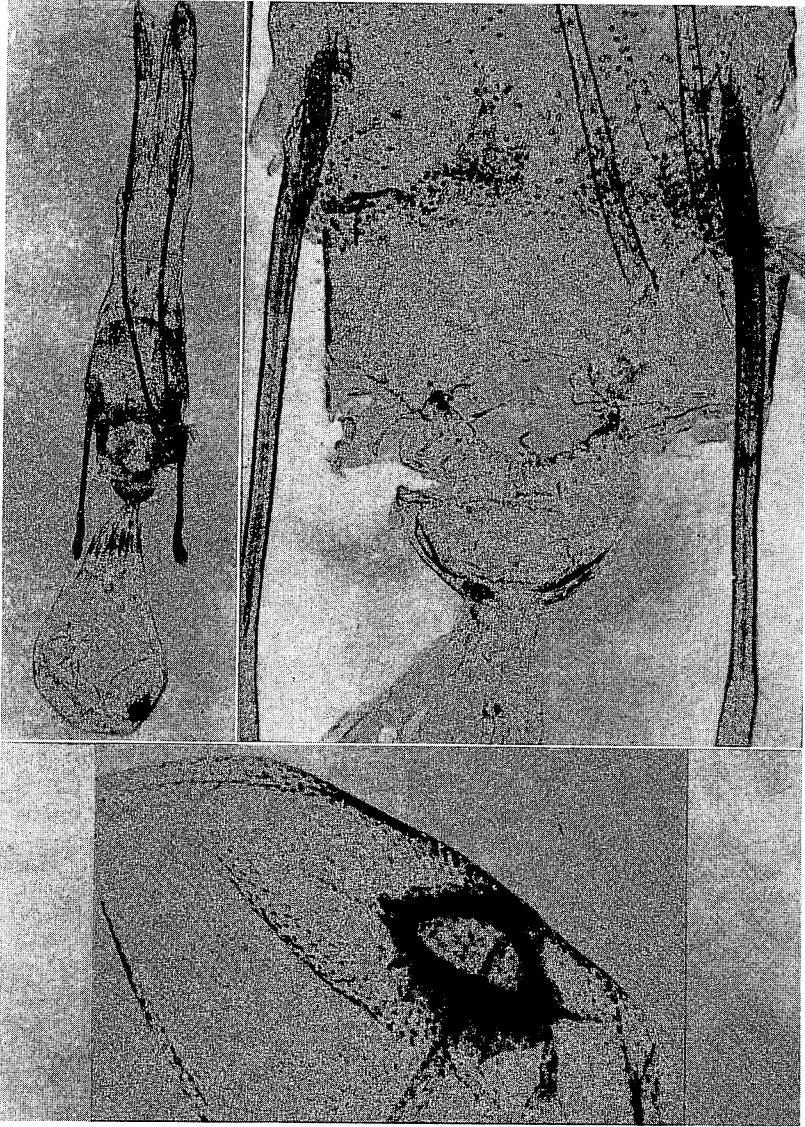


Figure 27—Genitalia of *Scotorythra apicalis* Swezey, allotype female; Kilauea, Hawaii.

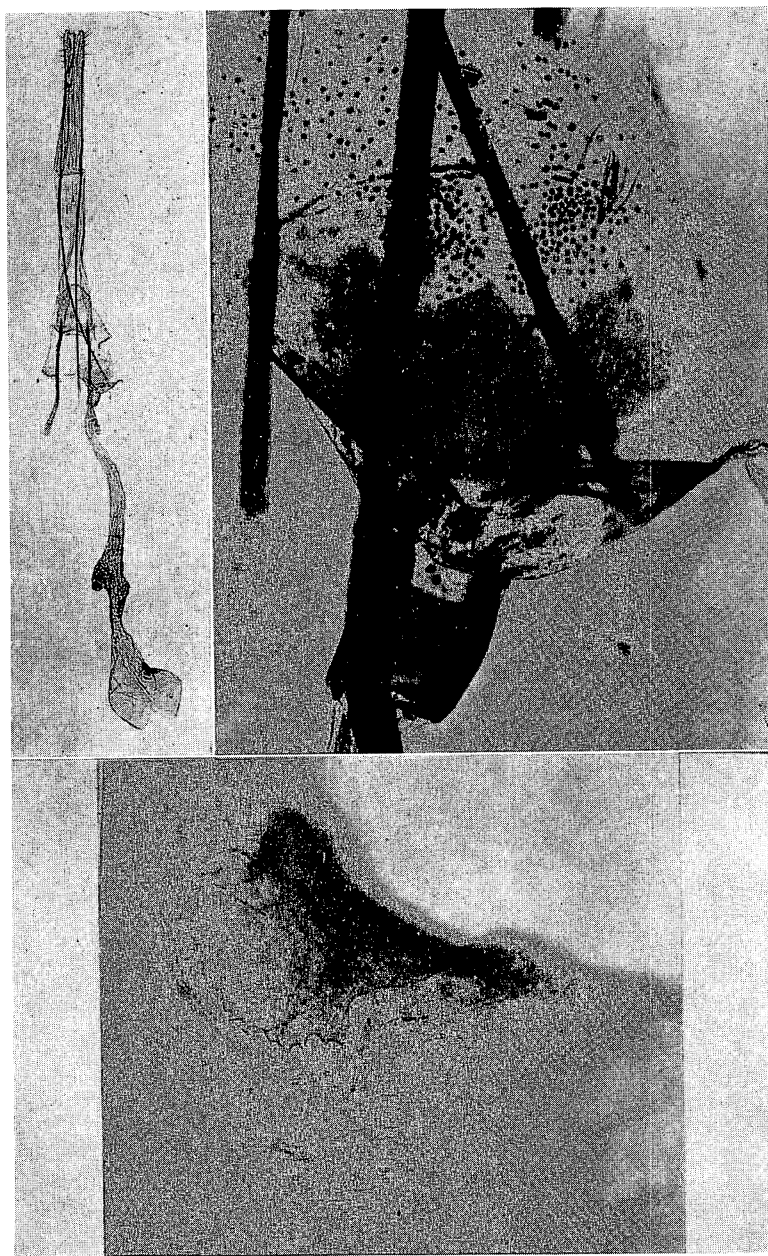


Figure 28—Female genitalia of *Scotorythra artemidora* Meyrick; Olaa, Hawaii.



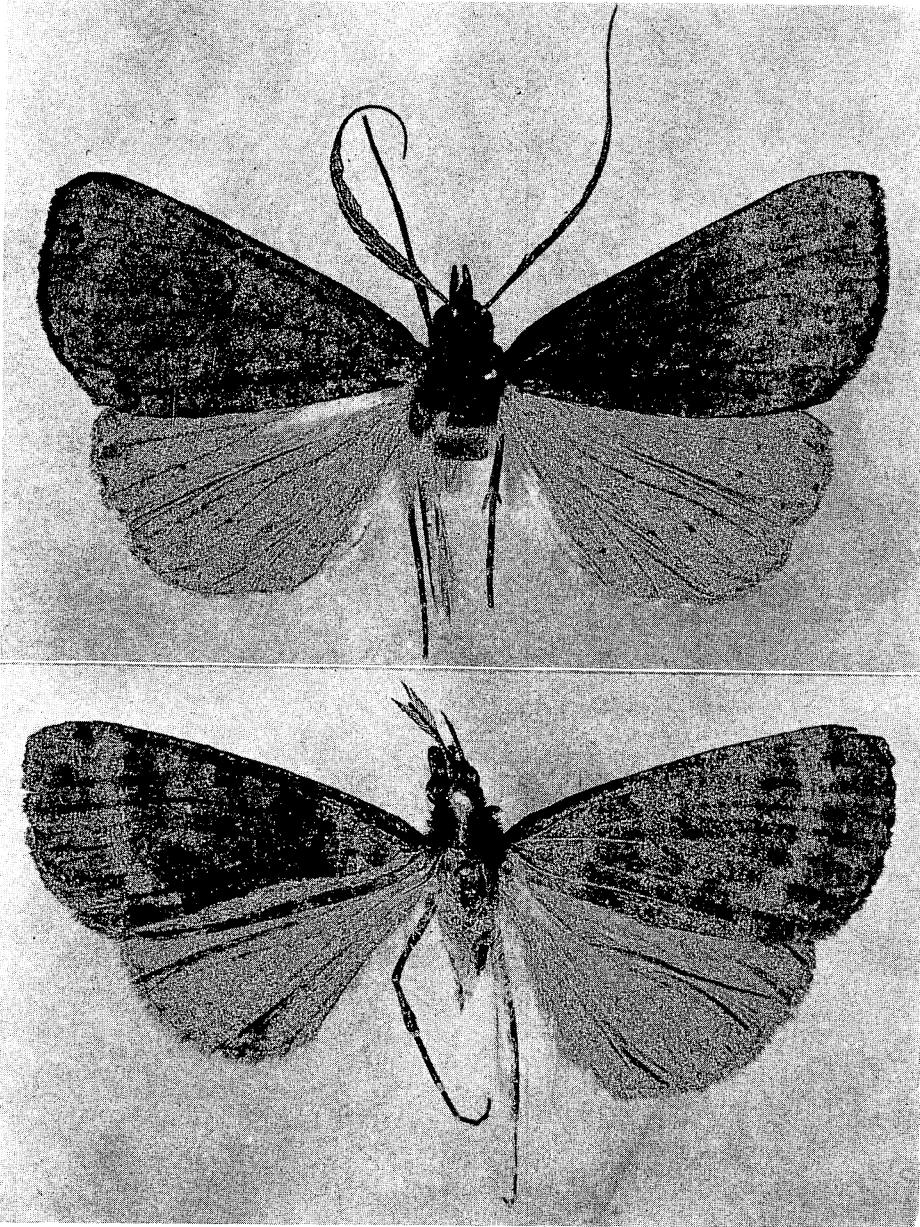


Figure 29—Above: *Scotorythra brunnea* (Warren), from the male type of *brachytarsa* Meyrick, a synonym; Olaa, Hawaii; expanse, 45 mm. Below: *capnopa* Meyrick, male type; Hawaii; expanse, 36 mm.

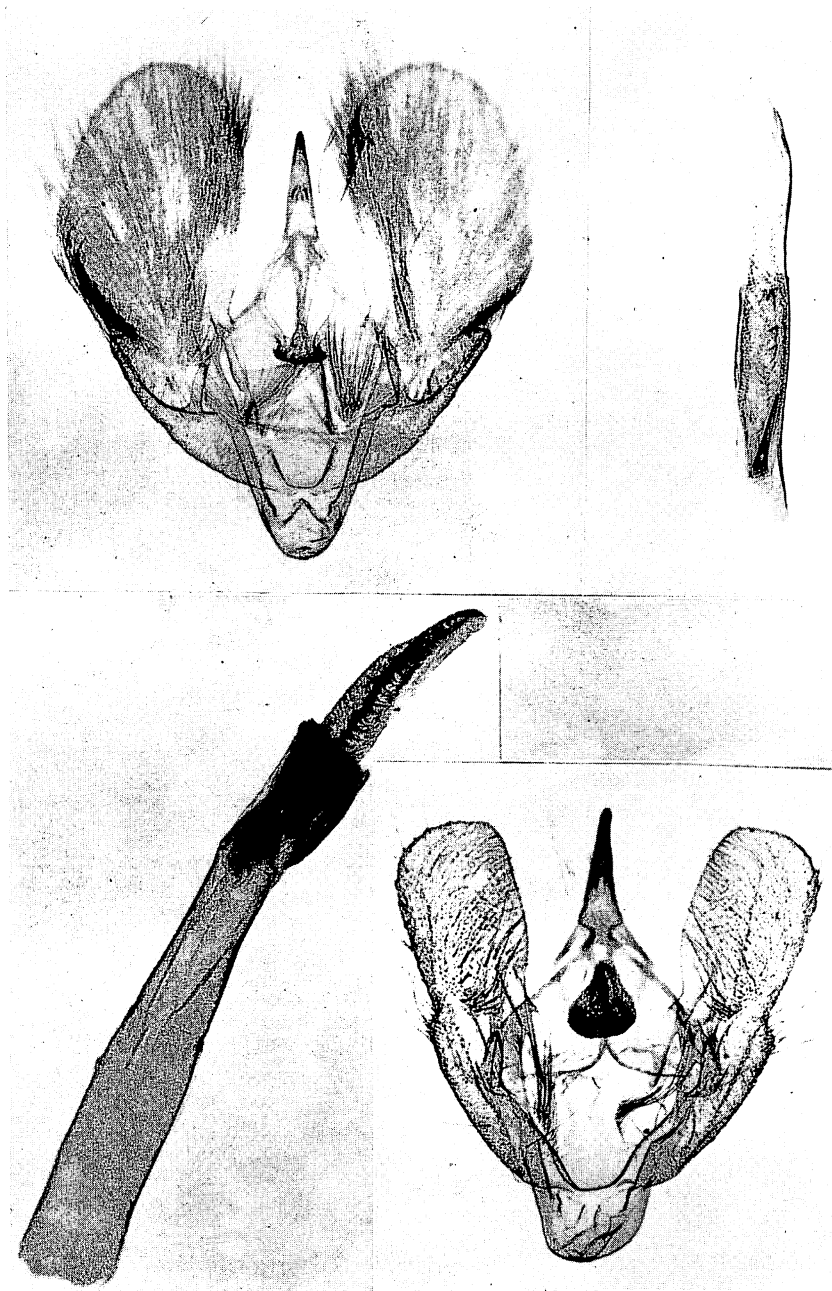


Figure 30—Above: Male genitalia of *Scotorythra artemidora* Meyrick, type; Olaa, Hawaii. Below: Of *brunnea* (Warren) from an example from Olaa, Hawaii, previously called *brachytarsa*. The internal sac is partially extruded from the aedeagus; compare next figure.

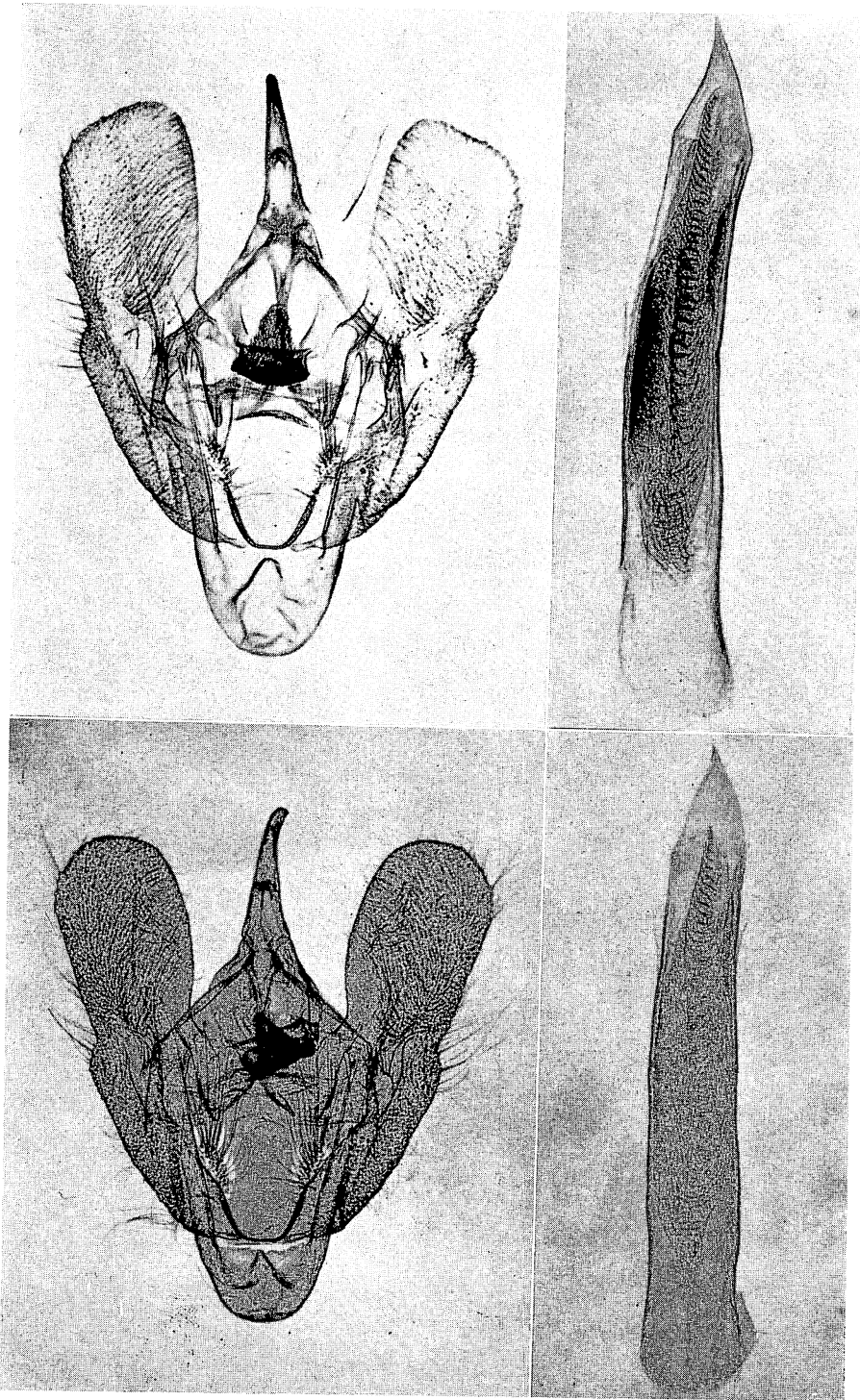


Figure 31—Above: Male genitalia of *Scotorythra brunnea* (Warren) from the type of *brachytarsa* Meyrick, a synonym; Olaa, Hawaii. Below: the type of *brunnea* (Warren); Olaa, Hawaii.

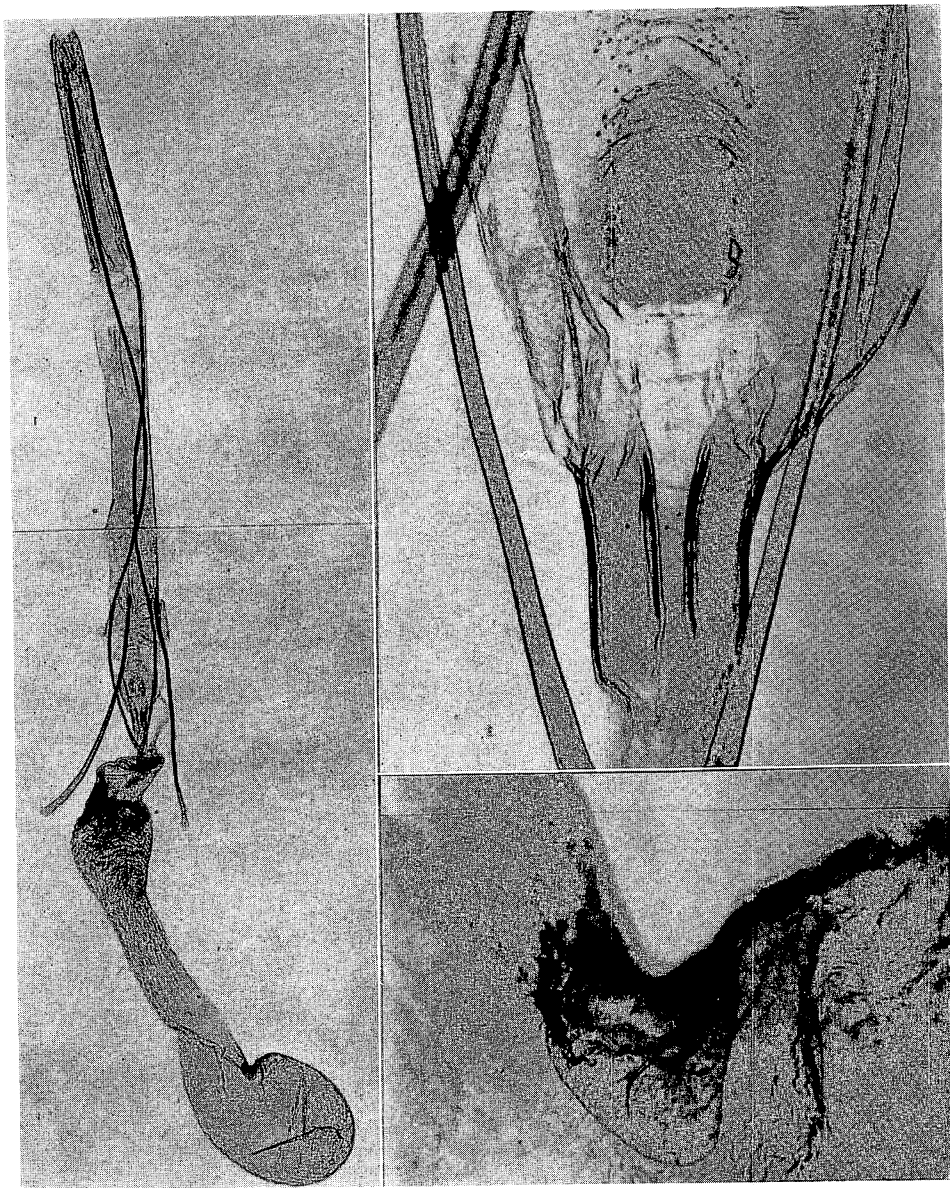


Figure 32—Female genitalia of *Scotorythra brunnea* (Warren); Oloa, Hawaii.



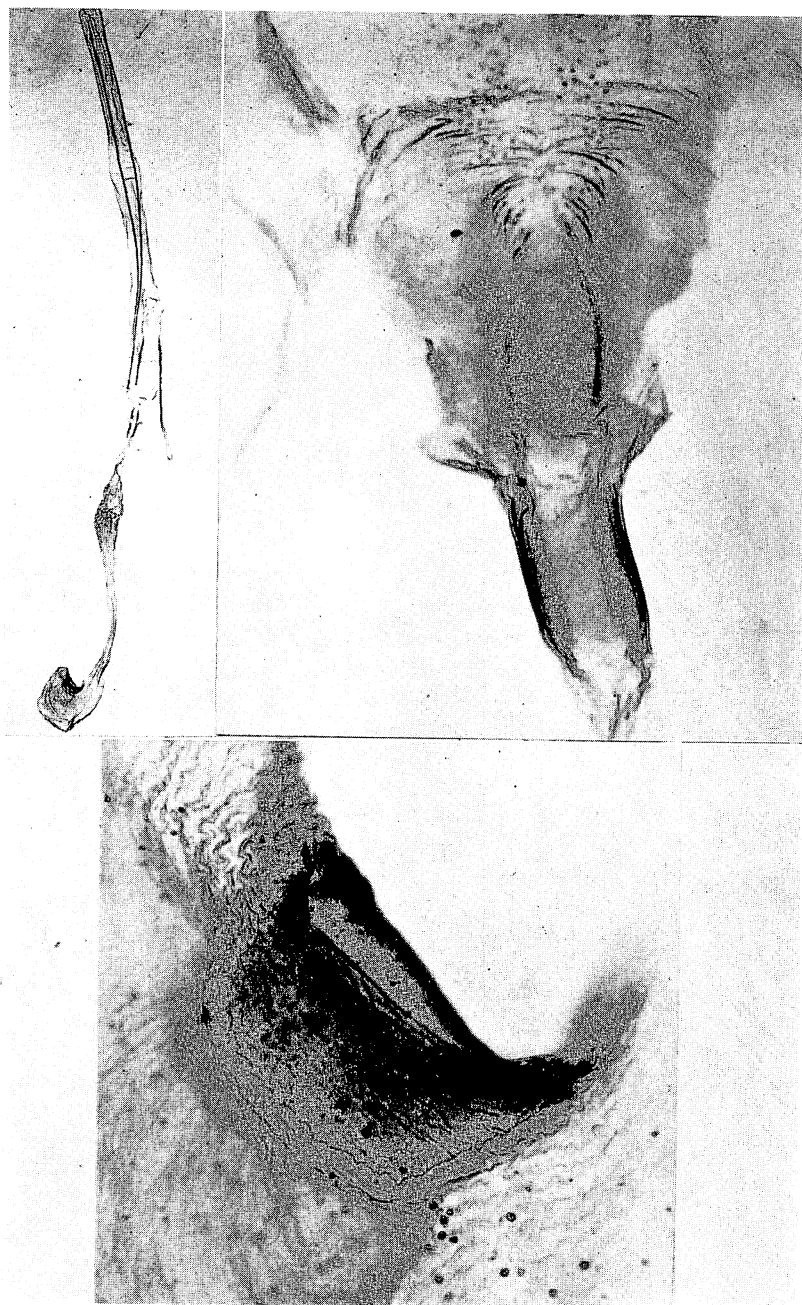


Figure 33—Female genitalia of *Scotorythra capnopa* Meyrick; Olaa, Hawaii.

**Scotorythra crocorrhoa** Meyrick (figs. 42, 46).*Scotorythra crocorrhoa* Meyrick, 1928:95.

Endemic. Kauai (type locality: Kokee).

Hostplant: Unknown.

**Scotorythra demetrias** Meyrick (figs. 42, 44, 105).*Scotorythra demetrias* Meyrick, 1899:180, pl. 4, fig. 32.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

**Scotorythra diceraunia** Meyrick (figs. 43, 45, 47, 105).*Scotorythra diceraunia* Meyrick, 1900:258; 1904:354.

Endemic. Oahu, Molokai (exact type locality not known), Maui.

Hostplant: Reared from guava, but native hostplant unknown to me.

This species was described from four examples taken on Molokai by Shauinsland. The type is in Bremen. Meyrick said: "To this species I now refer without doubt the specimen (of unknown locality) formerly assigned by me as the ♀ of *S. goniastis*; it is entirely similar to the ♀ now obtained."

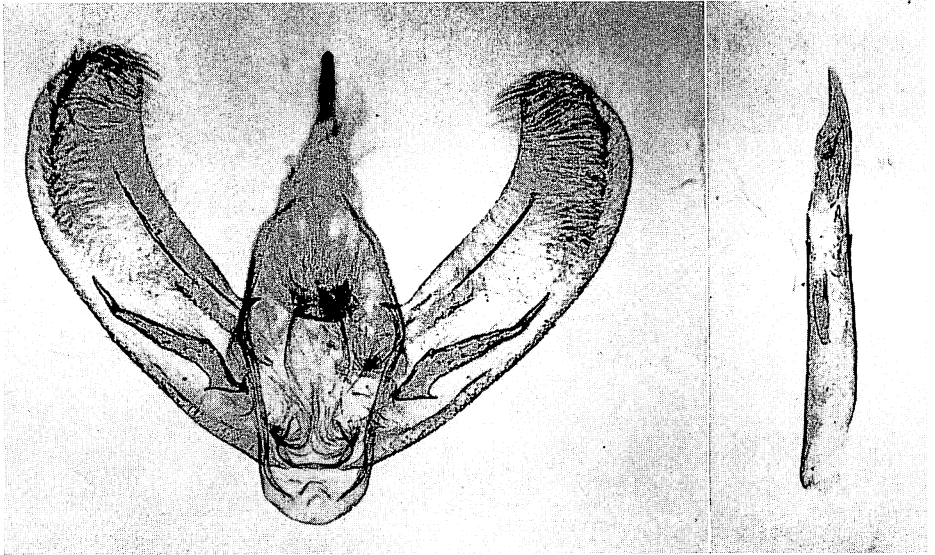


Figure 34—Male genitalia of *Scotorythra caryopsis* Meyrick; from the type of the synonym *isopora* Meyrick.

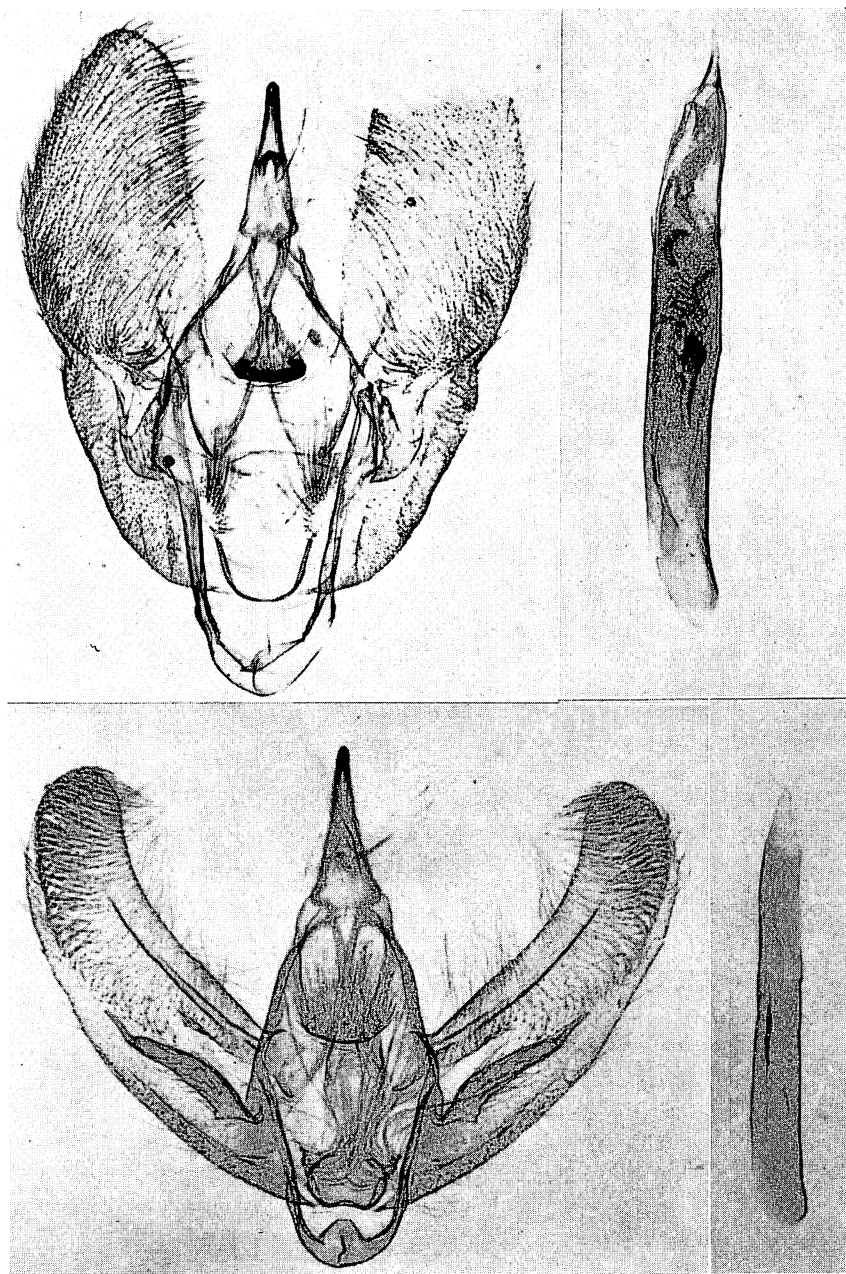


Figure 35—Above: Male genitalia of *Scotorythra capnopa* Meyrick, type; Olaa, Hawaii. Below: Of *caryopsis* Meyrick, type; Pauoa Valley, Oahu.



Figure 36—Female genitalia of *Scolorythra caryopsis* Meyrick; mountains near Honolulu.

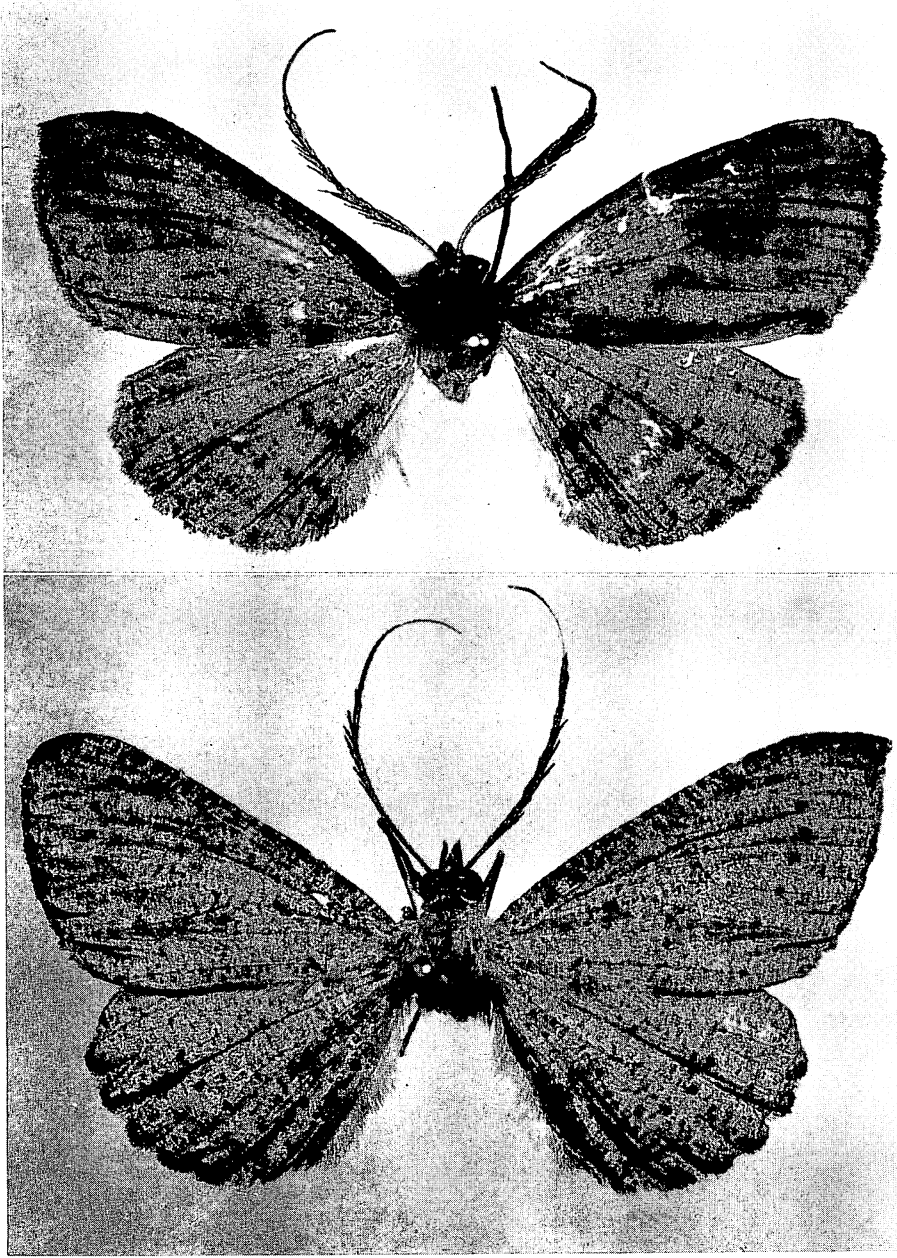


Figure 37—Above: *Scotorythra caryopsis* Meyrick, type male; Pauoa Valley, Oahu, 500 feet; expanse, 26 mm.; (a rubbed example and not in good condition; the crenulations on the hind wing are normally more strongly developed in perfect specimens, as in the lower figure). Below: The male type of *isopora* Meyrick; Kauai, 4,000 feet; a synonym of *caryopsis*.



This is much like *brunnea*, but on all examples seen, the antemedial and post-medial lines in the fore wing are continuous white lines. The medial spot in the fore wing on all examples studied is pale, but on an occasional *brunnea* the spot is also pale instead of dark, as it is in most examples. The hind tarsus is somewhat variable in length; on some examples it is only one-half the length of the tibia, but on others it is slightly more than one-half as long as a tibia.

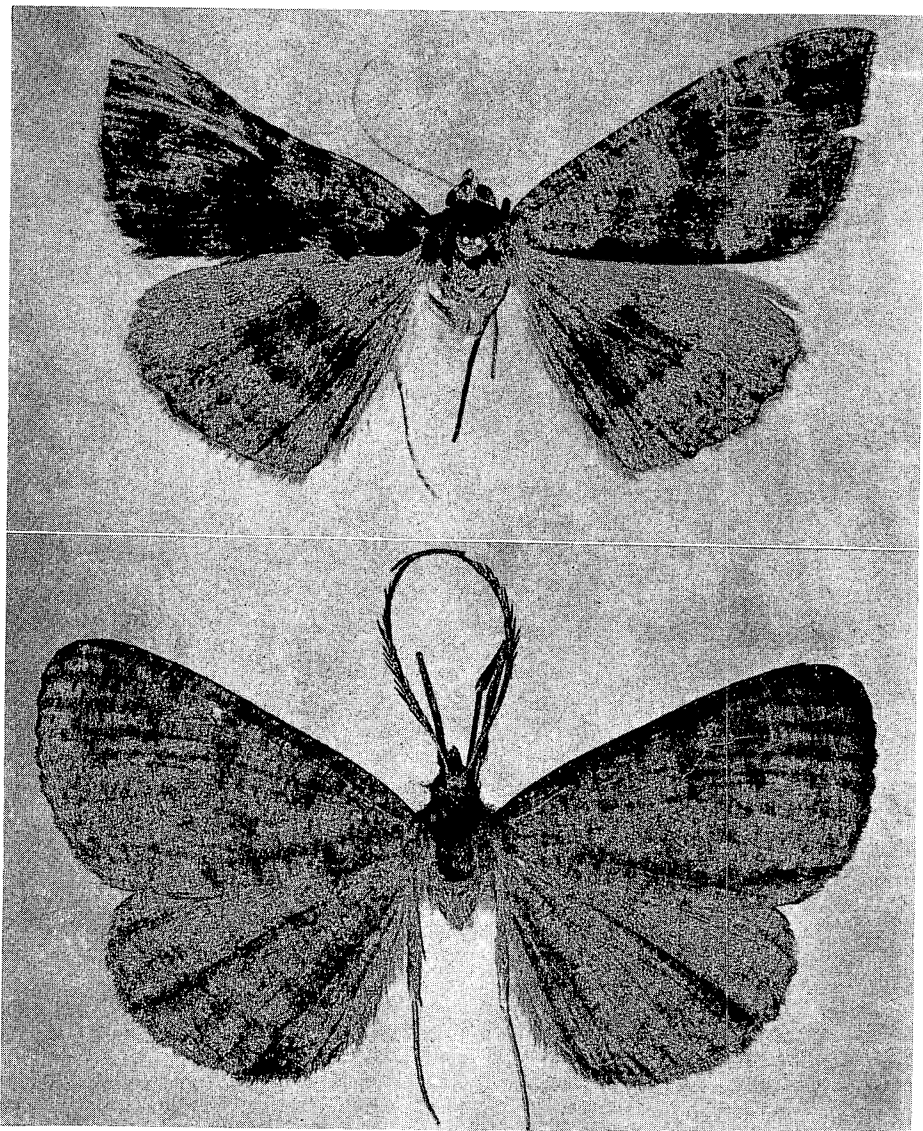


Figure 38—Above: *Scotorythra corticea* (Butler), female type; expanse, 33 mm.; "Hawaiian Islands 81-7"; a worn, deformed example. Below: Type male of the synonym *aruraea* Meyrick; Kilauea, Hawaii.

**Scotorythra dissotis** Meyrick (figs. 48, 49, 51, 105).

*Scotorythra dissotis* Meyrick, 1904:351.

Endemic. Oahu (type locality: northwest Koolau Mountains).

Hostplant: Unknown.

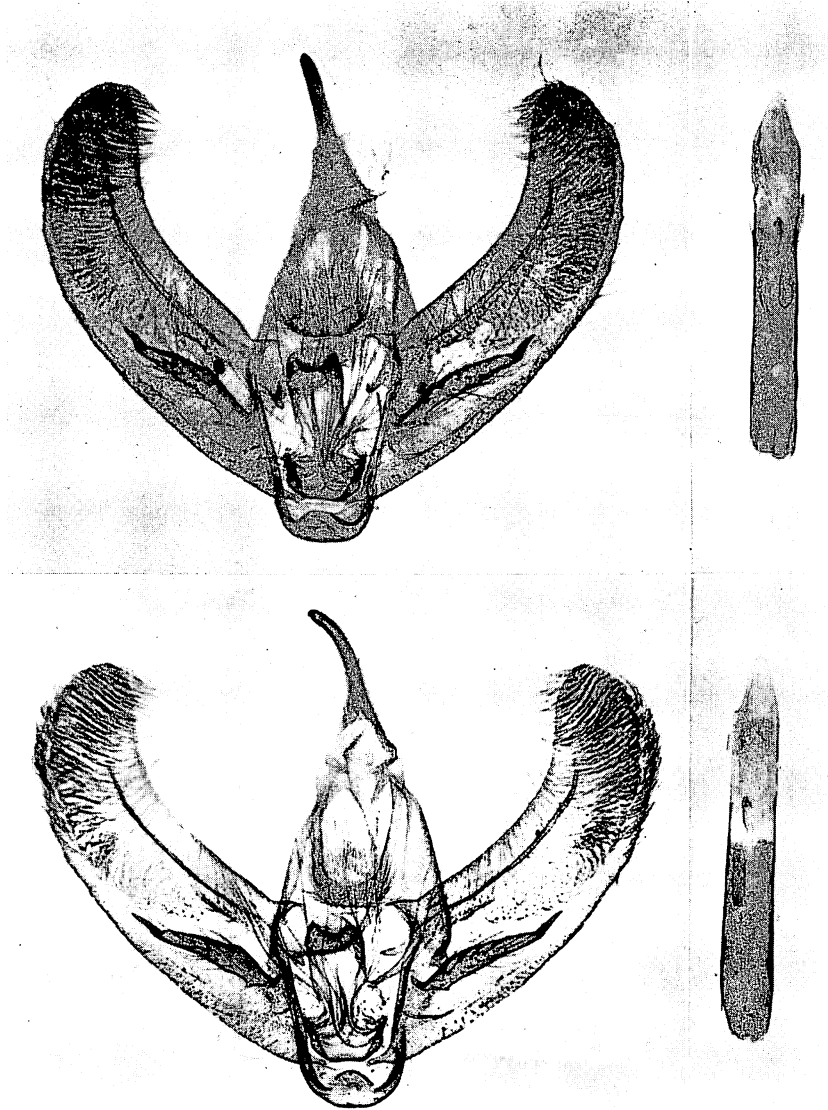


Figure 39—Above: Male genitalia of *Scotorythra corticea* (Butler); Kula Pipe Line Trail, Maui.  
Below: The type of the synonym *aruraea* Meyrick; Kilauea, Hawaii.

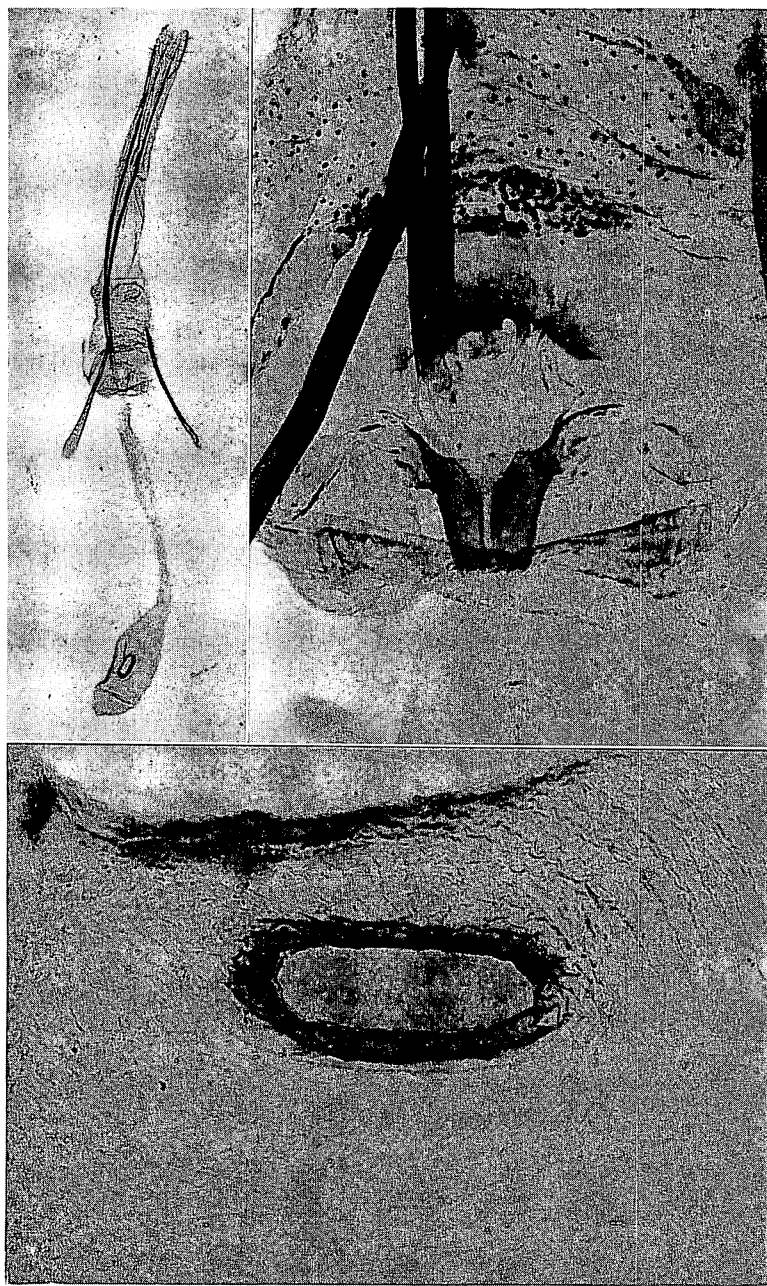


Figure 40—Female genitalia of the type of *Scotorythra corticea* (Butler).



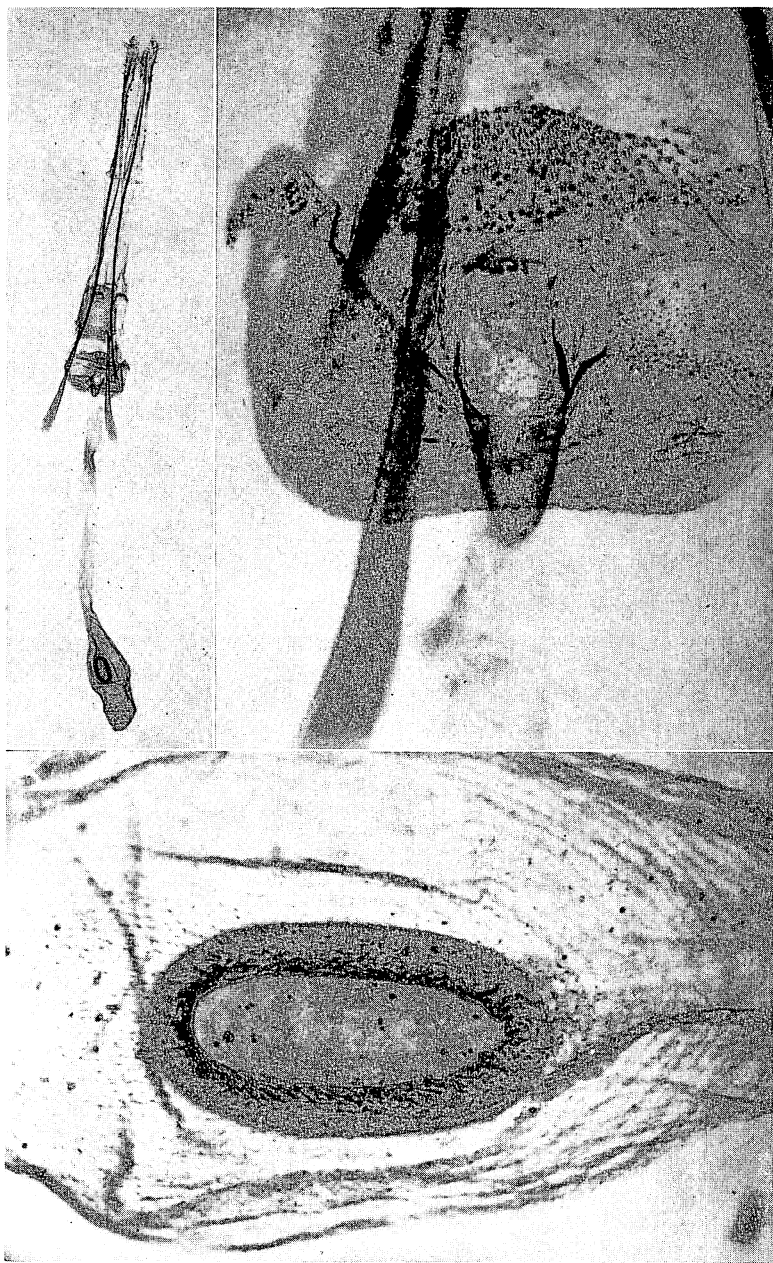


Figure 41—Female genitalia of *Scotorythra aruraea* Meyrick; Kona, Hawaii; a synonym of *corticea* (Butler).

**Scotorythra epicyma** Meyrick (figs. 48, 50).

*Scotorythra epicyma* Meyrick, 1899:174.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: Unknown.

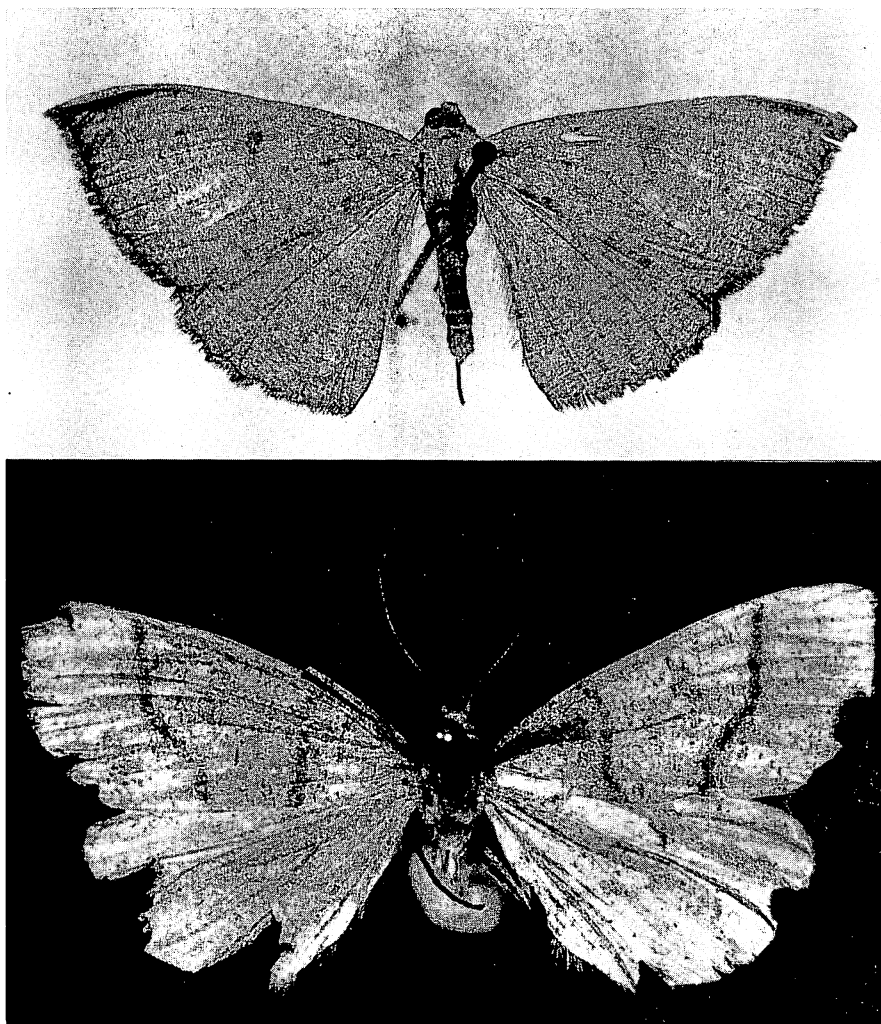


Figure 42—Above: *Scotorythra crocorrhoa* Meyrick, female type; expanse, 37 mm.; Kokee, Kauai. Below: *demetrias* Meyrick, type male; expanse, 31 mm.; Kilauea, Hawaii.

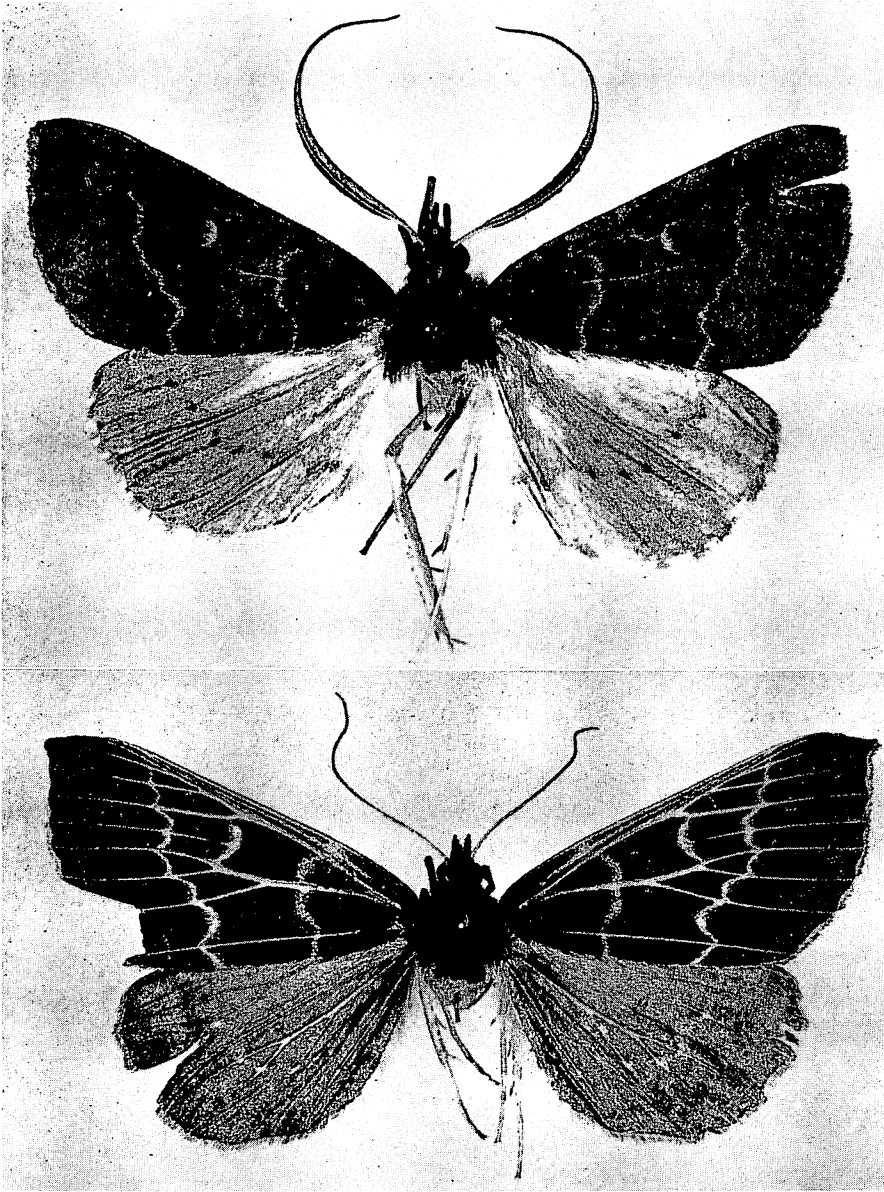


Figure 43—*Scotorythra diceraunia* Meyrick. Above: Male; southeastern Koolau Mts., Oahu; expanse, 38 mm. Below: Female; expanse, 51 mm.; from the same locality.

**Scotorythra epixantha** (Perkins), **new combination** (figs. 17, 51, 52, 53, 54, 105).

*Nesochlide epixantha* Perkins, 1901:216. Meyrick, 1904:350. Type of *Nesochlide*.

Endemic. Oahu (type locality: northwest Koolau Mountains).

Hostplant: Unknown.

"Whereas the male is readily attracted by flowers of the Ohia (*Metrosideros*) and to light, the female apparently comes to neither of these attractions." (Perkins, 1906:41).

I have concluded that it is best to regard Perkins' genus *Nesochlide*, which he erected for this species, as a synonym of *Scotorythra*. The only character which has been used to maintain *Nesochlide* is that in the male of this species there is a peculiar patch of specialized scales on the under side of the cell in the fore wing. This "sex patch" consists of a dense, mud-like, oval patch of gray, matted hairs. Behind and partly overlapping this patch is a large number of very large, broad, almost ribbon-like, white scales. This is just an emphasized form of the tendency toward the development of secondary sexual characters as displayed in *Scotorythra*

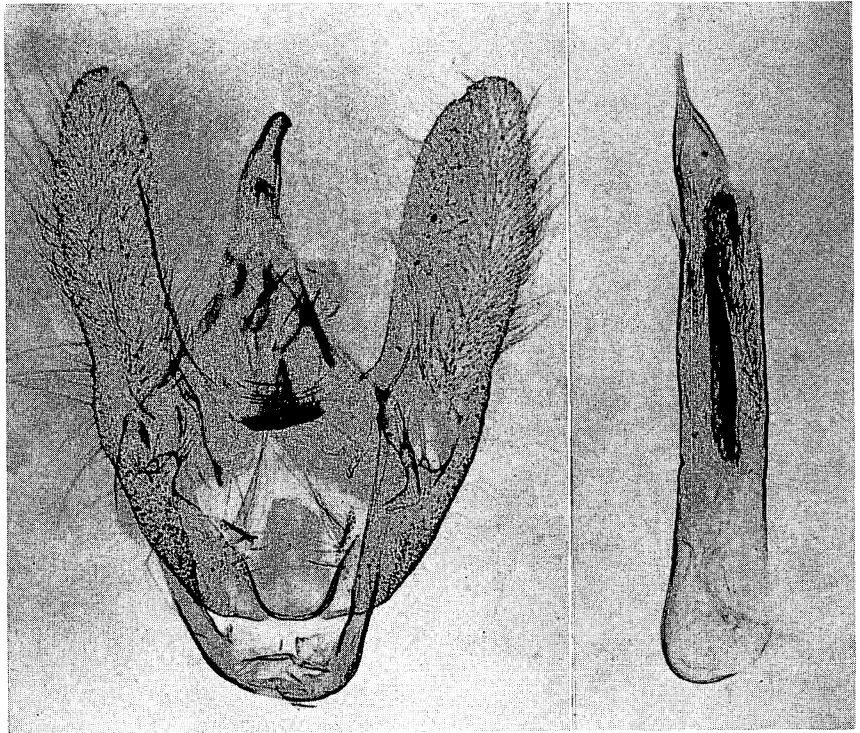


Figure 44—Male genitalia of the type of *Scotorythra demetrius* Meyrick; Kilauea, Hawaii.

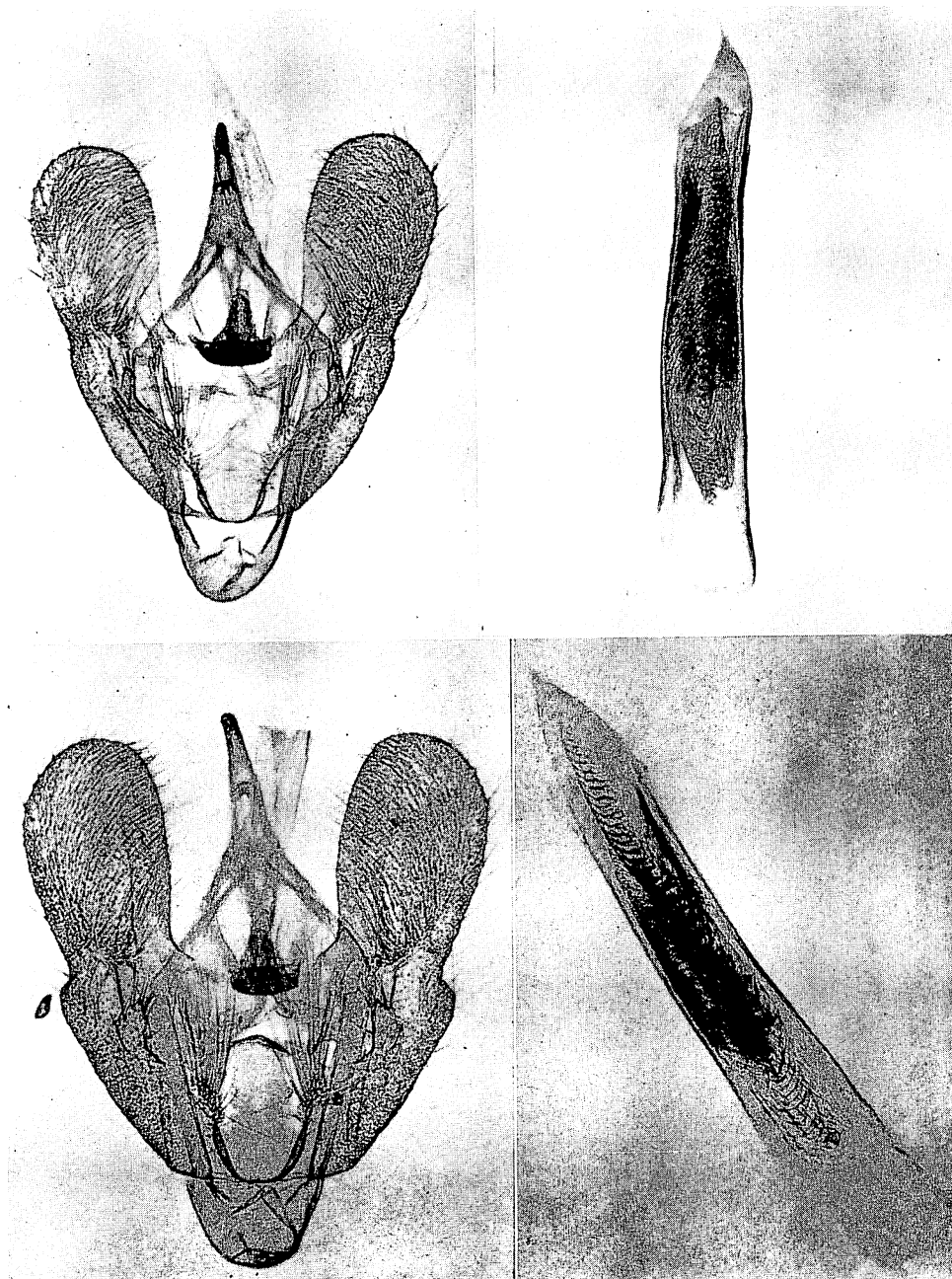


Figure 45—Male genitalia of two examples of *Scotorythra diceraunia* Meyrick. Above: From southeastern Koolau Mts., Oahu. Below: From Kainalu, Molokai.



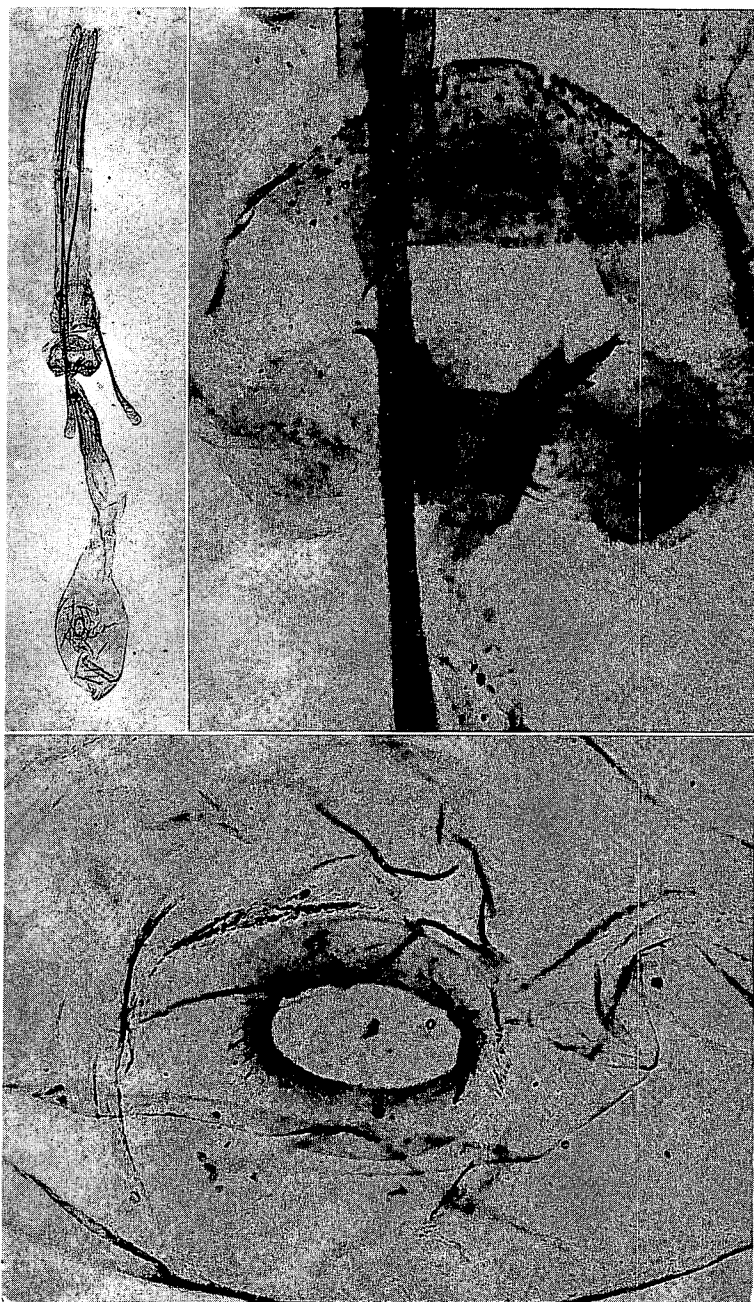


Figure 46—Female genitalia of *Scotorythra crocorrhoa* Meyrick, paratype; Kokee, Kauai.

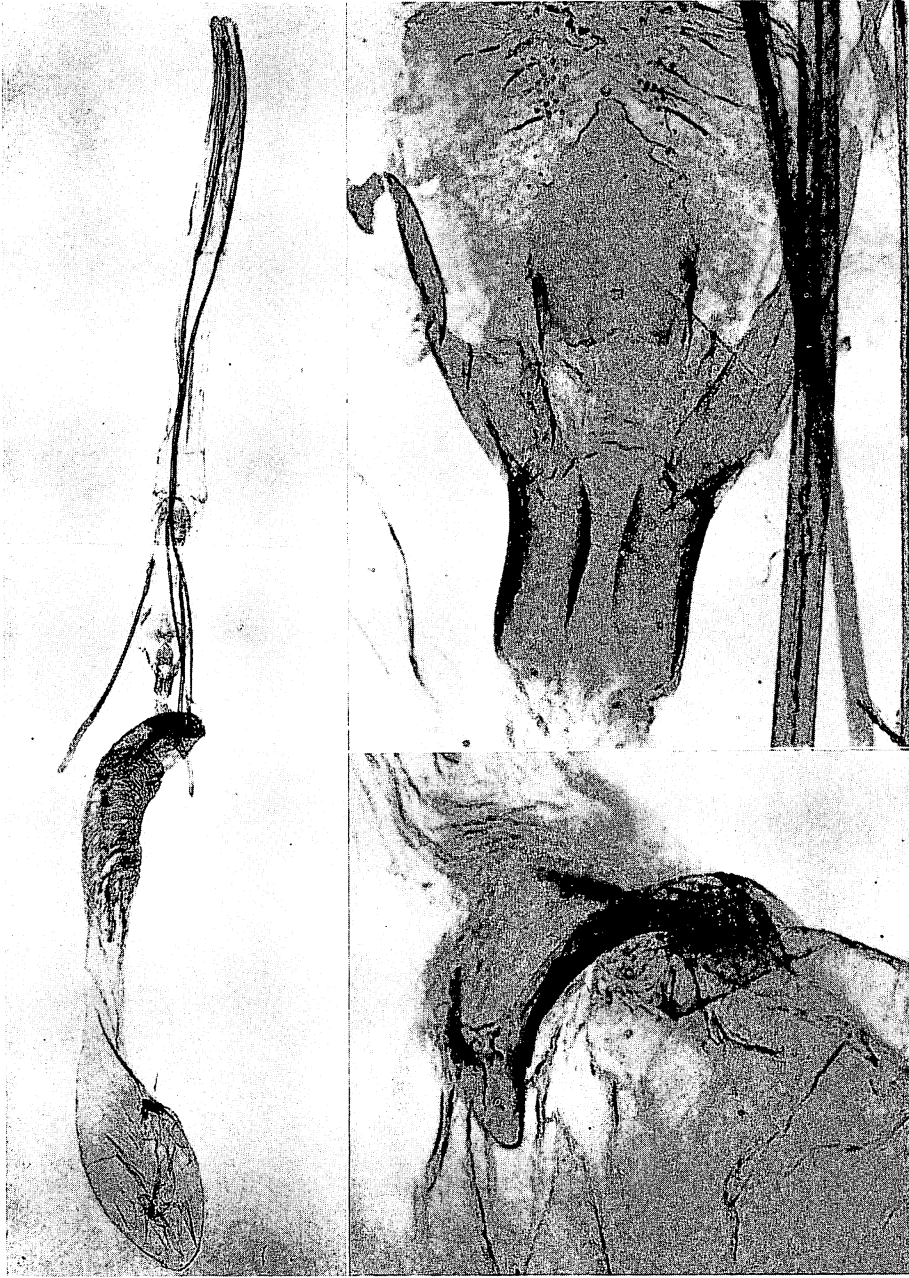


Figure 47—Female genitalia of *Scotorythra diceraunia* Meyrick; southeastern Koolau Mts., Oahu.

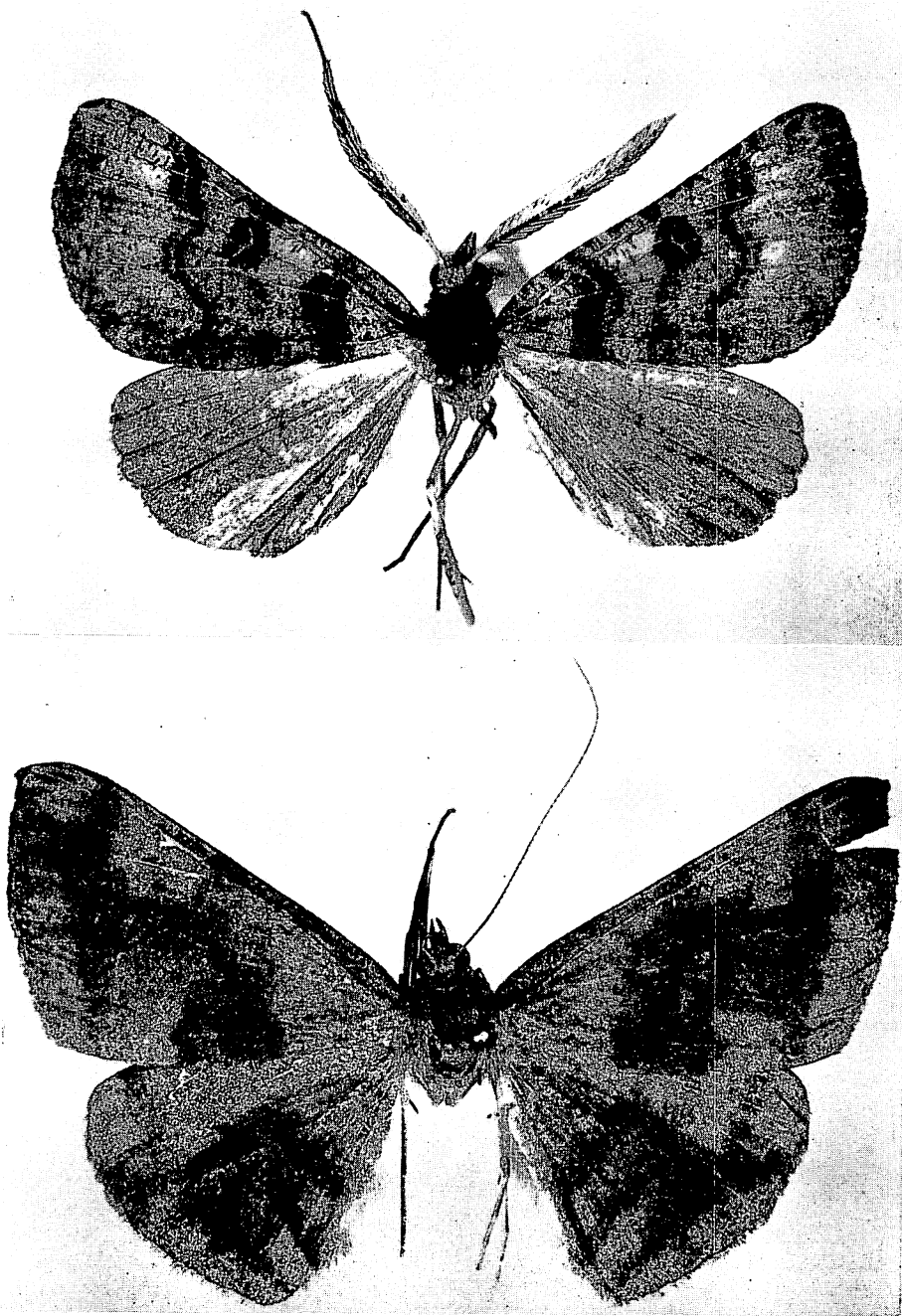


Figure 48—Above: *Scotorythra dissotis* Meyrick, male type; northwestern Koolau Mts., Oahu; expanse, 31 mm. Below: The female type of *epicyma* Meyrick; Kaholuamano, Kauai; expanse, 41 mm.



*trachyopsis*, it has no corresponding character in the female, and I do not consider it of generic value. The male has the upper side of the fore wing orange colored, and the hind wing is white with very little marking; the dark pattern in the fore wing is variable. Perkins said that he had only taken two females, but many males have been captured.

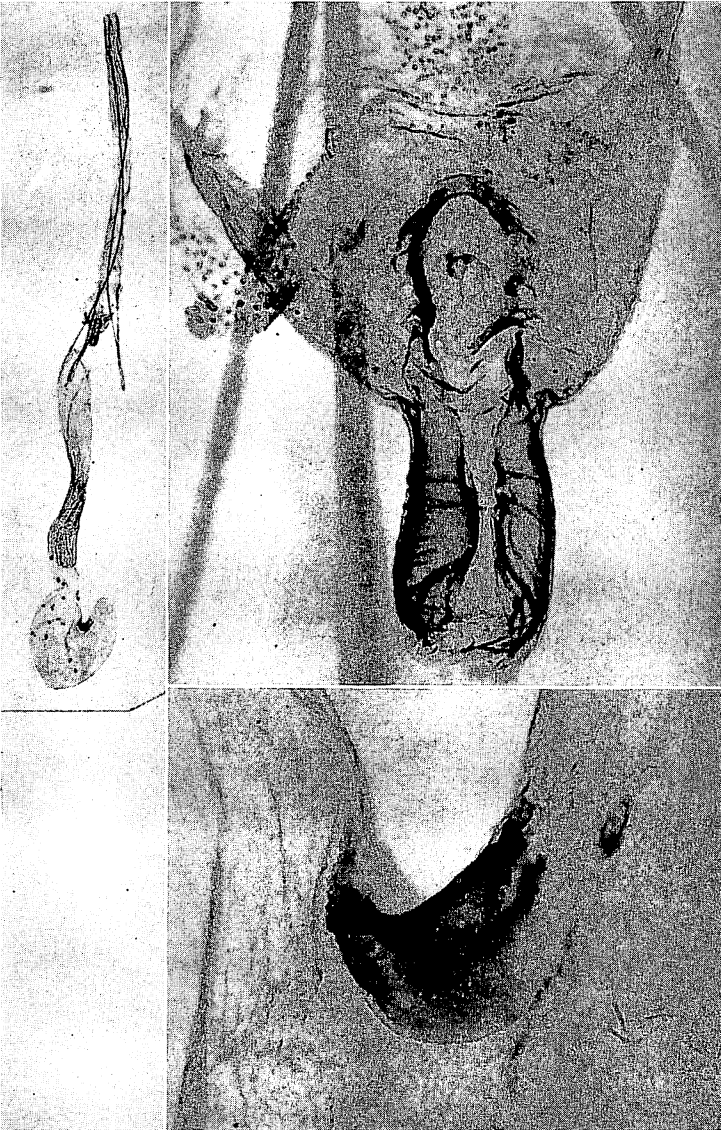


Figure 49—Female genitalia of *Scotorythra dissotis* Meyrick; northwestern Koolau Mts., Oahu.

**Scotorythra euryphaea** Meyrick (figs. 53, 55, 58).

*Scotorythra euryphaea* Meyrick, 1899:188, pl. 5, fig. 4: 1904:354.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Probably *Metrosideros*.

The subbasal patch of spines on the abdomen of the male is absent.

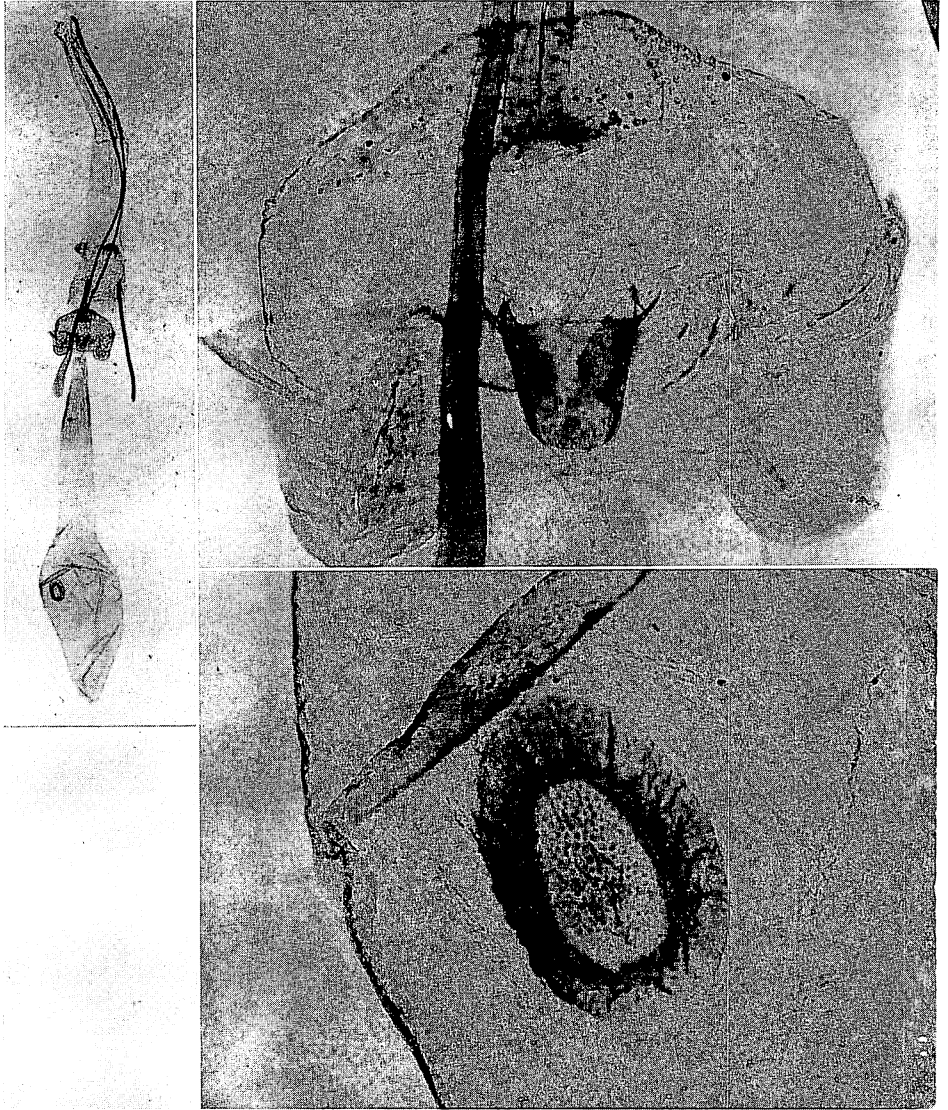


Figure 50—Female genitalia of the type of *Scotorythra epicyma* Meyrick; Kaholuamano, Kauai.

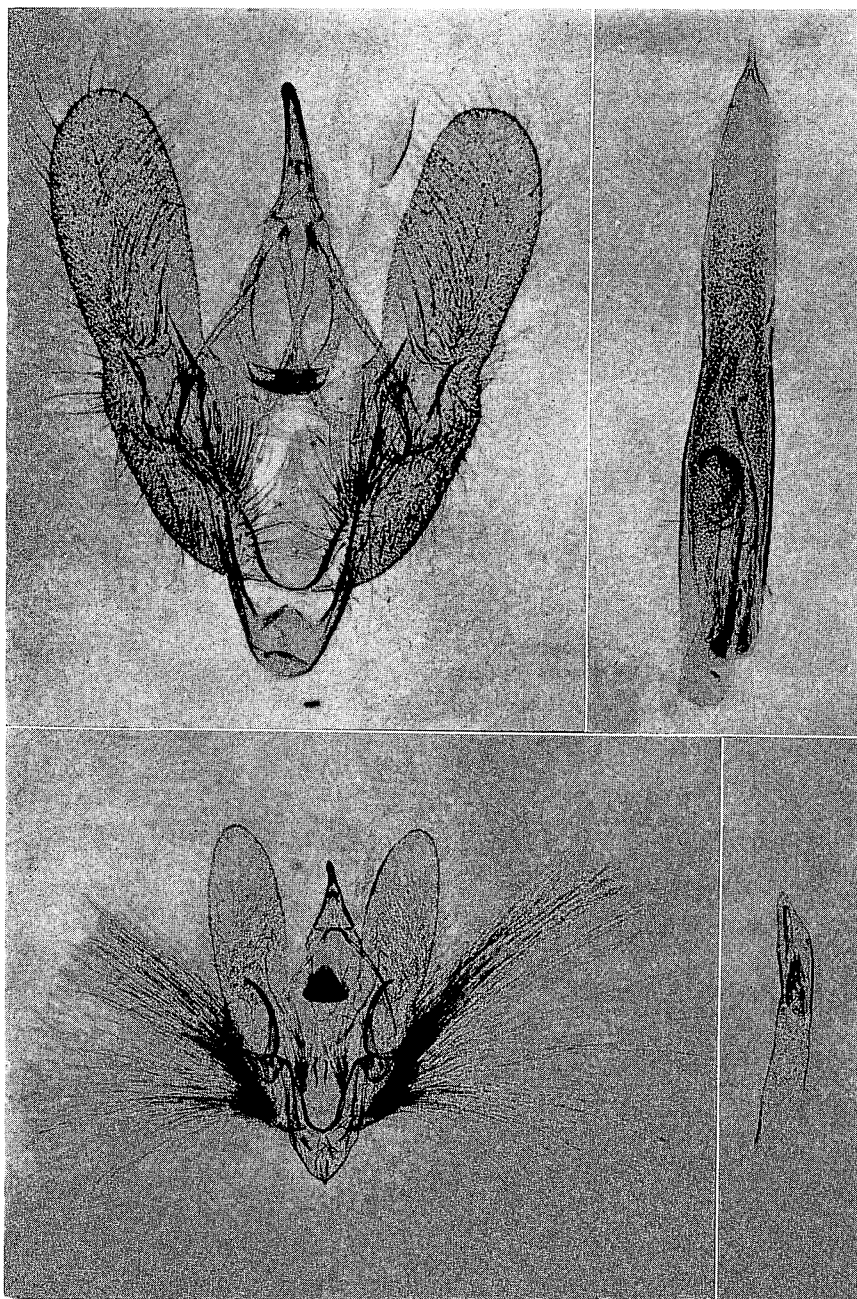


Figure 51—Above: Male genitalia of the type of *Scotorythra dissotis* Meyrick; northwestern Koolau Mts., Oahu. Below: Of the type of *epixantha* (Perkins); northwestern Koolau Mts., Oahu.

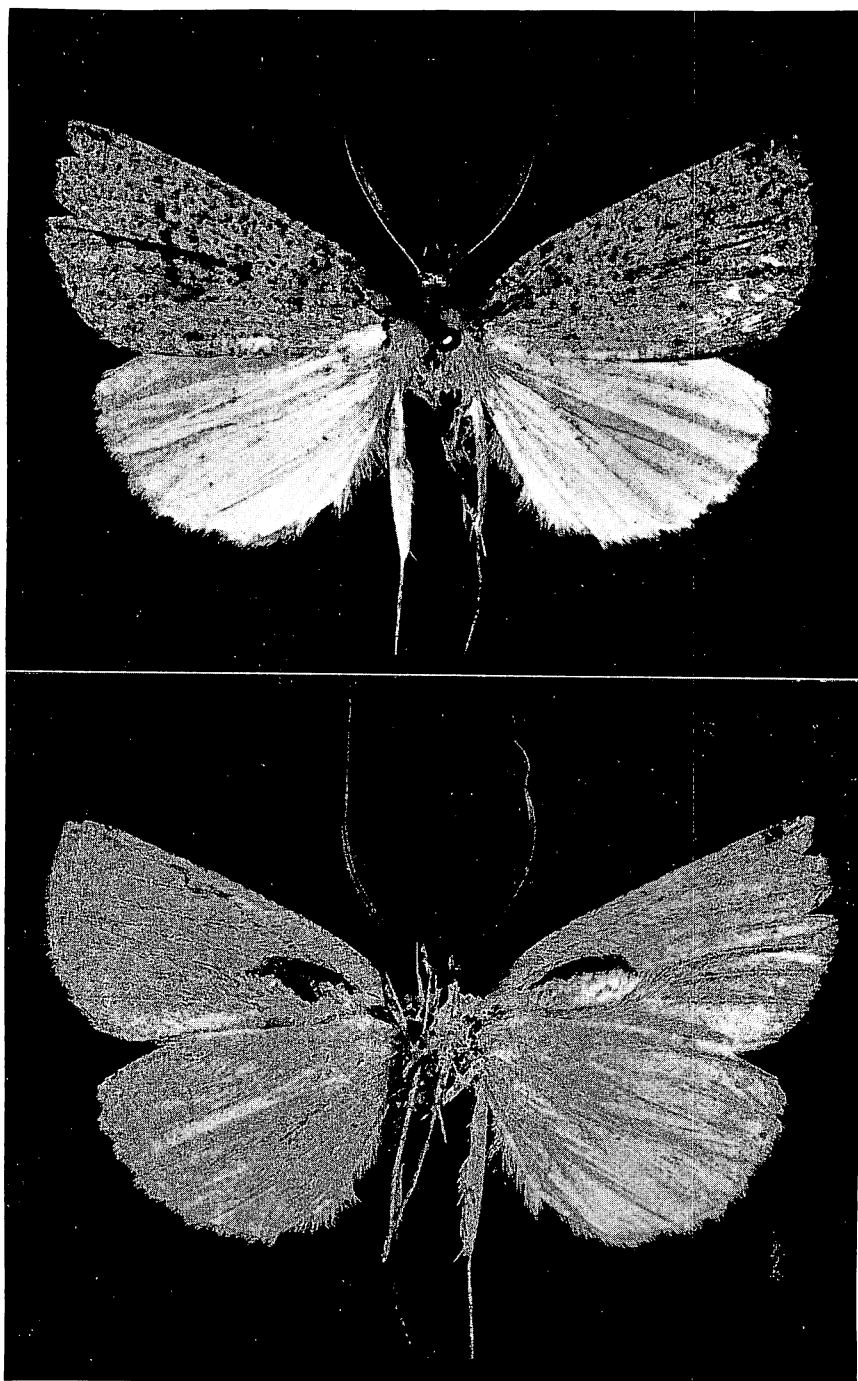


Figure 52—*Scolorythra epixantha* (Perkins). Dorsal and ventral surfaces of the male type; northwestern Koolau Mts., Oahu; expanse, 42 mm. Note the scale patches on the under sides of the fore wings, and compare the venation as shown in figure 17.

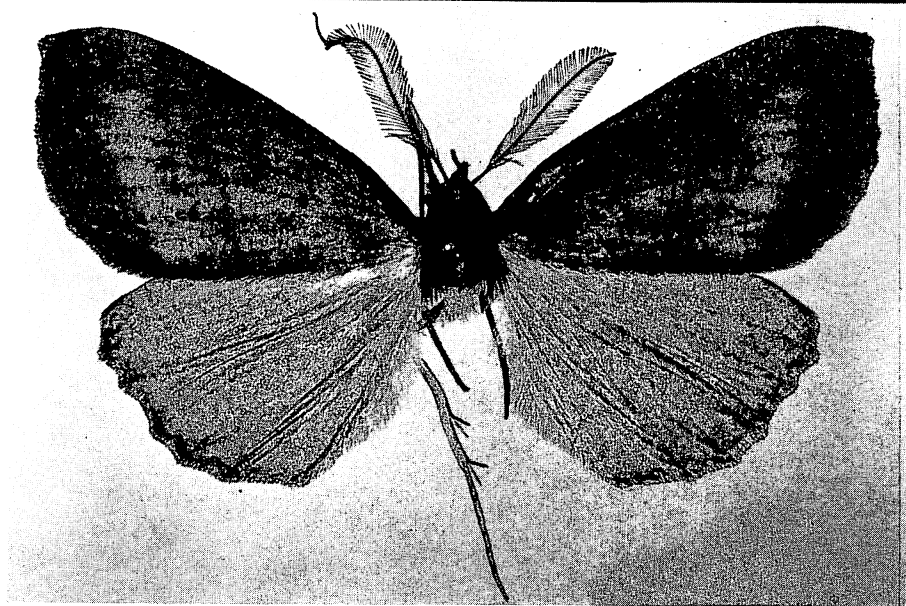
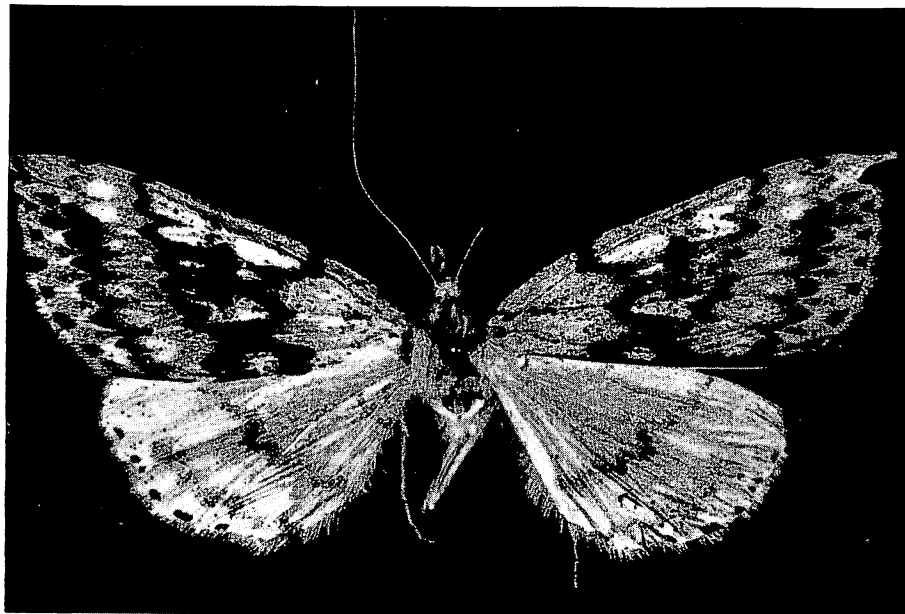


Figure 53—Above: *Scolorythra epixantha* (Perkins), female; northwestern Koolau Mts., Oahu; expanse, 49 mm. Below: The male type of *euryphaea* Meyrick; Haleakala, Maui, 5,000 feet; expanse, 50 mm.



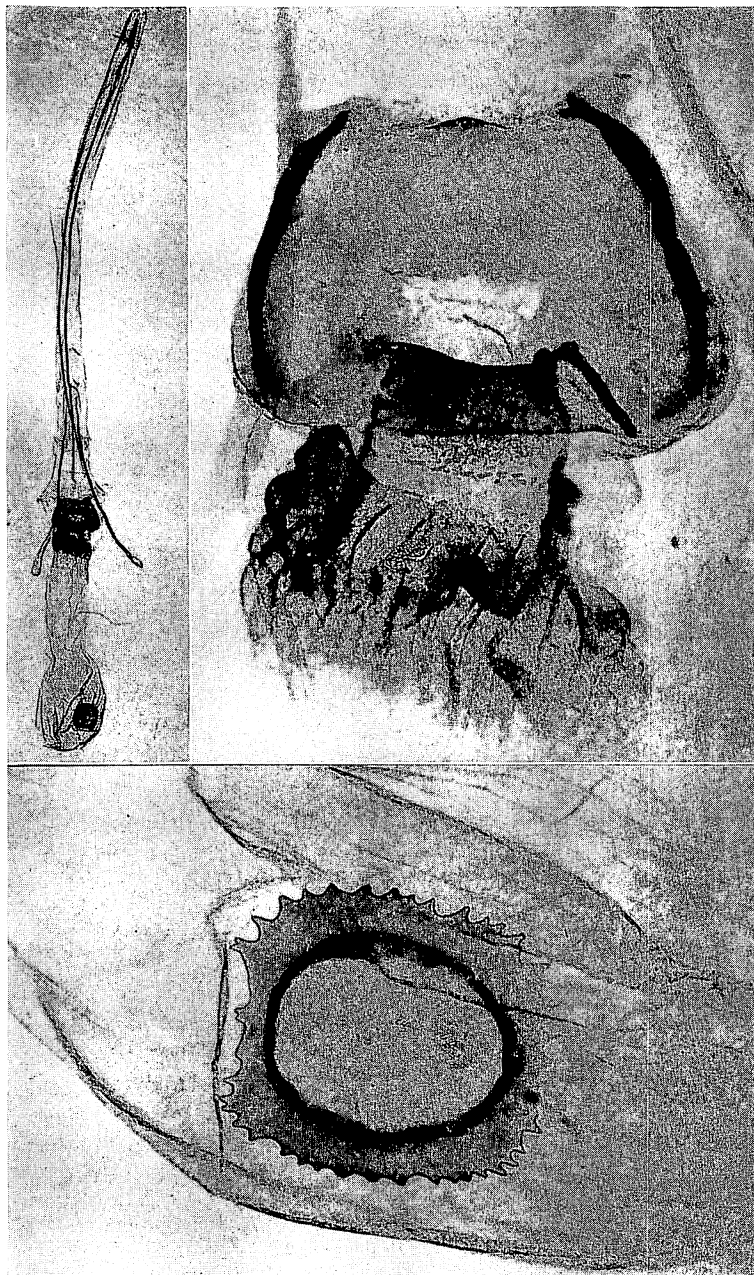


Figure 54—Female genitalia of *Scotorythra epixantha* (Perkins); northwestern Koolau Mts., Oahu.

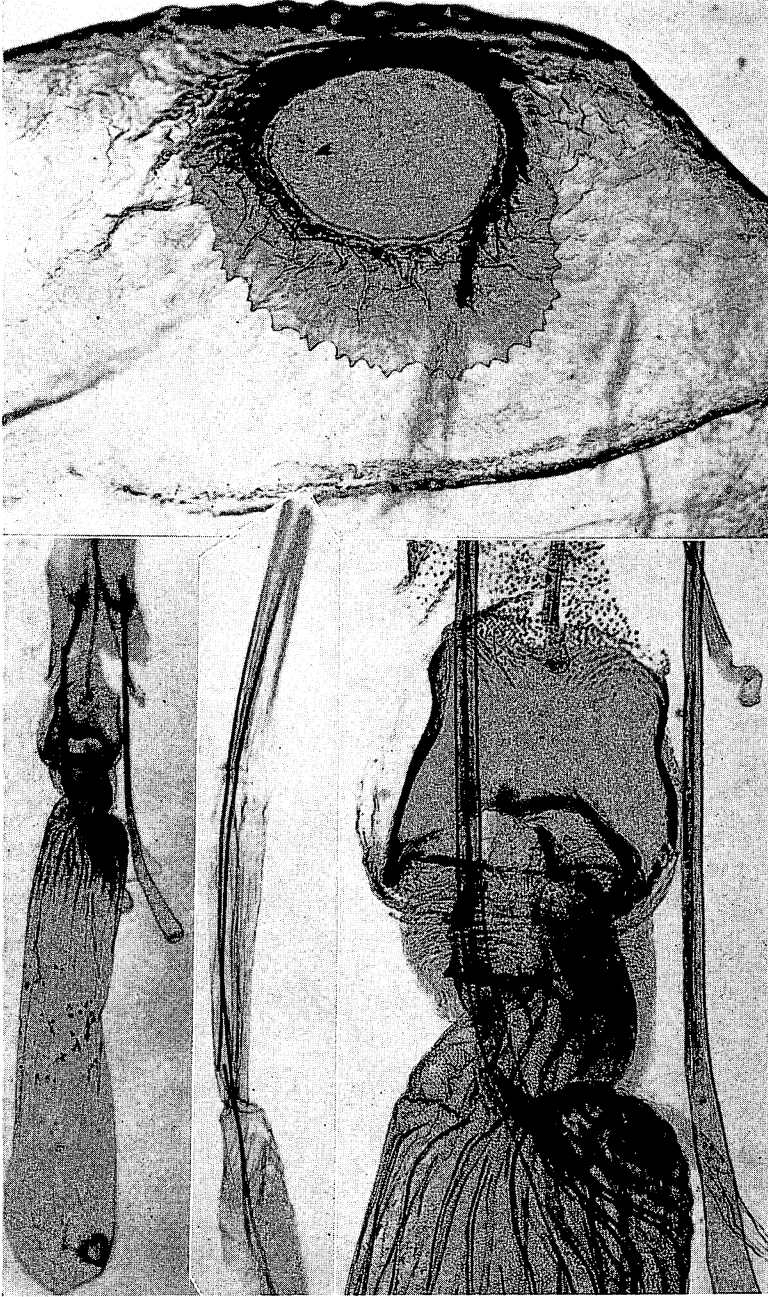


Figure 55—Female genitalia of *Scotorythra euryphaea* Meyrick; Kauai.

**Scotorythra gomphias** (Meyrick), new combination (figs. 17, 56, 57, 58, 59, 106).

*Sisyrophyta gomphias* Meyrick, 1899:169, pl. 4, fig. 27. Type of *Sisyrophyta*.

Endemic. Oahu, Molokai, Maui, Hawaii (type locality: Olaa).

Hostplants: *Bobea*, *Pisonia*, *Straussia*.

This species and *ochetias* were separated from *Scotorythra* because of the re-



Figure 56—Dorsal and ventral views of the male type of *Scotorythra gomphias* (Meyrick); Olaa, Hawaii; expanse, 51 mm. Note the modified scale masses on the under sides of the fore wings.



markable development of the vestiture of the under sides of the wings in the males. The two species are broadly rather similar, but are easily separated by the characters given in the key.

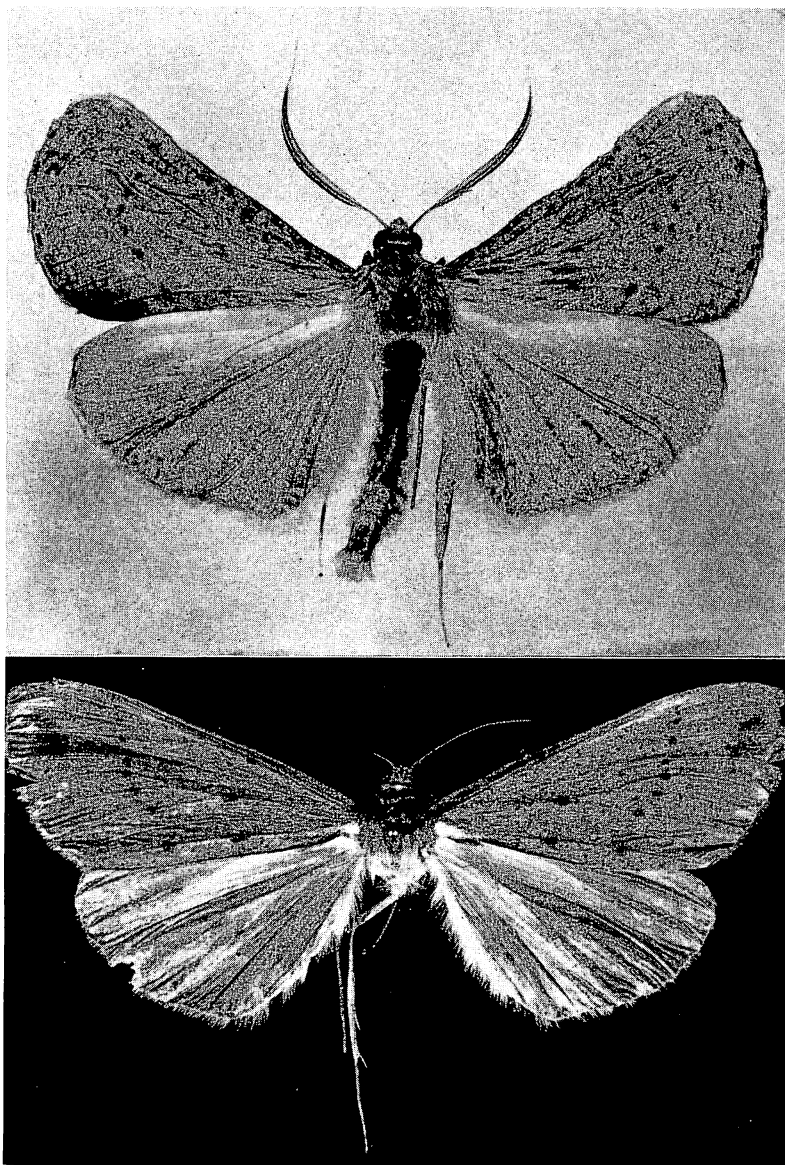


Figure 57—Above: *Scotorythra gomphias* (Meyrick); a male from Lulumahu Valley, Oahu, 1,800 feet; expanse, 54 mm. Below: A female paratype from Olaa, Hawaii; expanse, 57 mm.

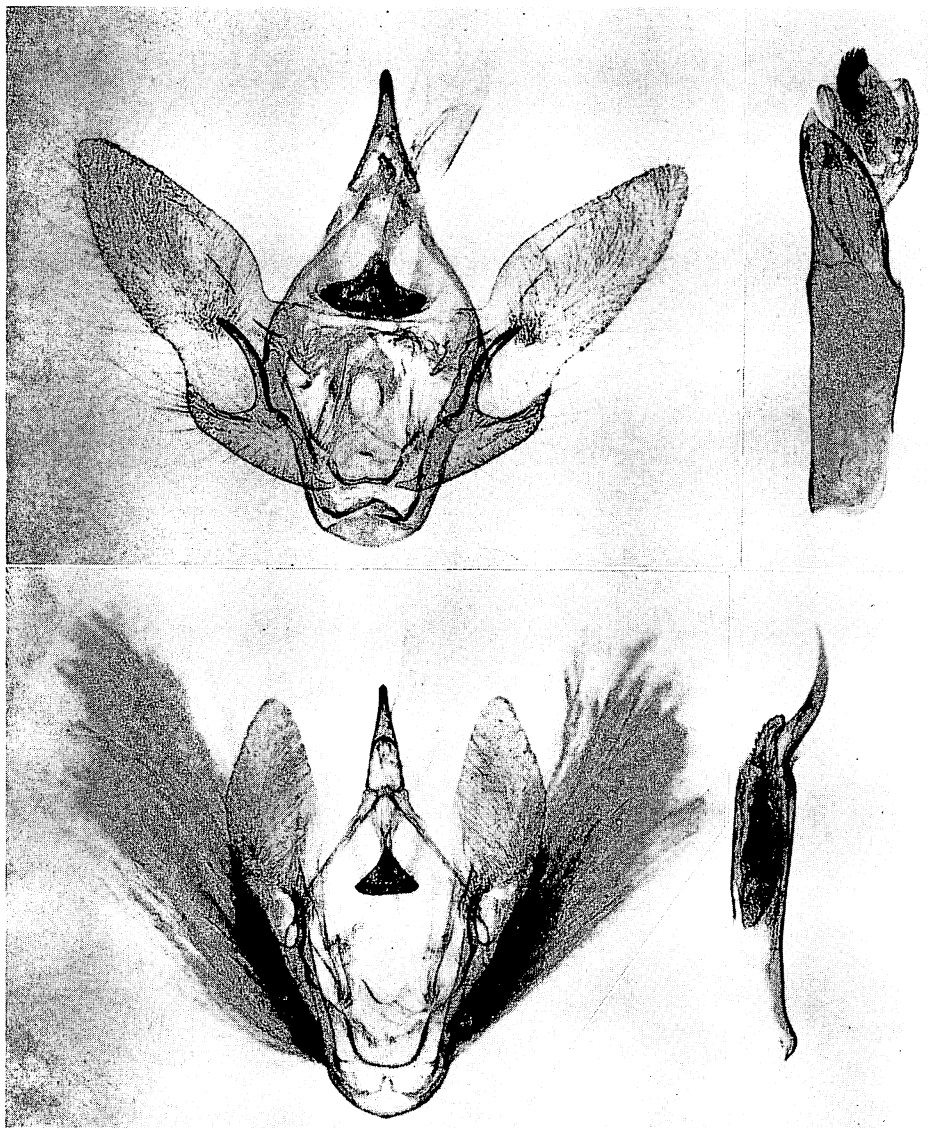


Figure 58—Above: Male genitalia of *Scotorythra euryphaea* Meyrick, type; Haleakala, Maui. Below: Of the type of *gomphias* (Meyrick) from Olaa, Hawaii.

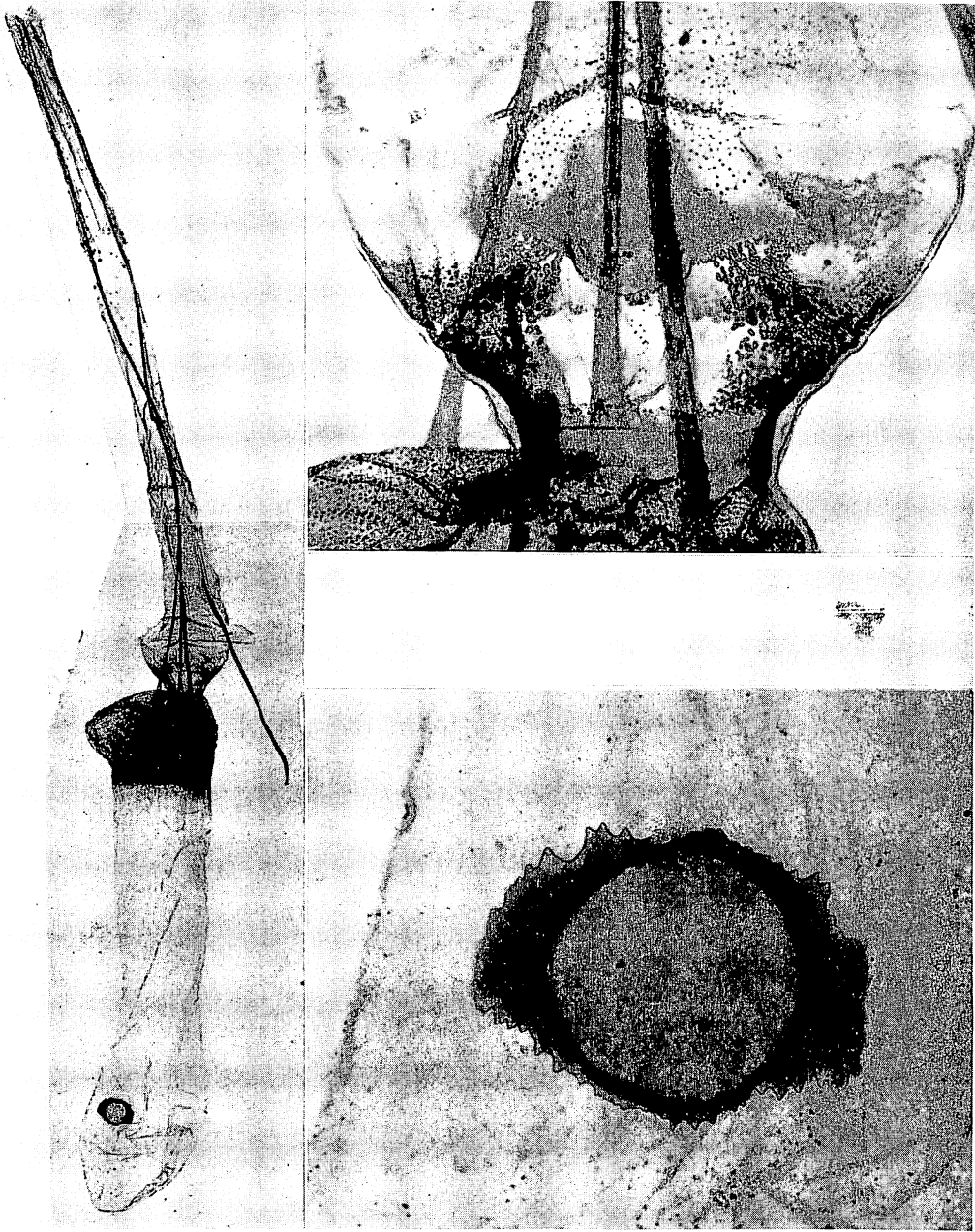


Figure 59—Female genitalia of *Scotorythra gomphias* (Meyrick); Olaa, Hawaii.



Figure 60—Above: *Scotorythra goniastis* Meyrick, female; Kilauea, Hawaii; expanse, 37 mm.  
Below: The female type of *hecataea* Meyrick; Waimea Mts., Kauai, 3,000 feet; expanse, 37 mm.

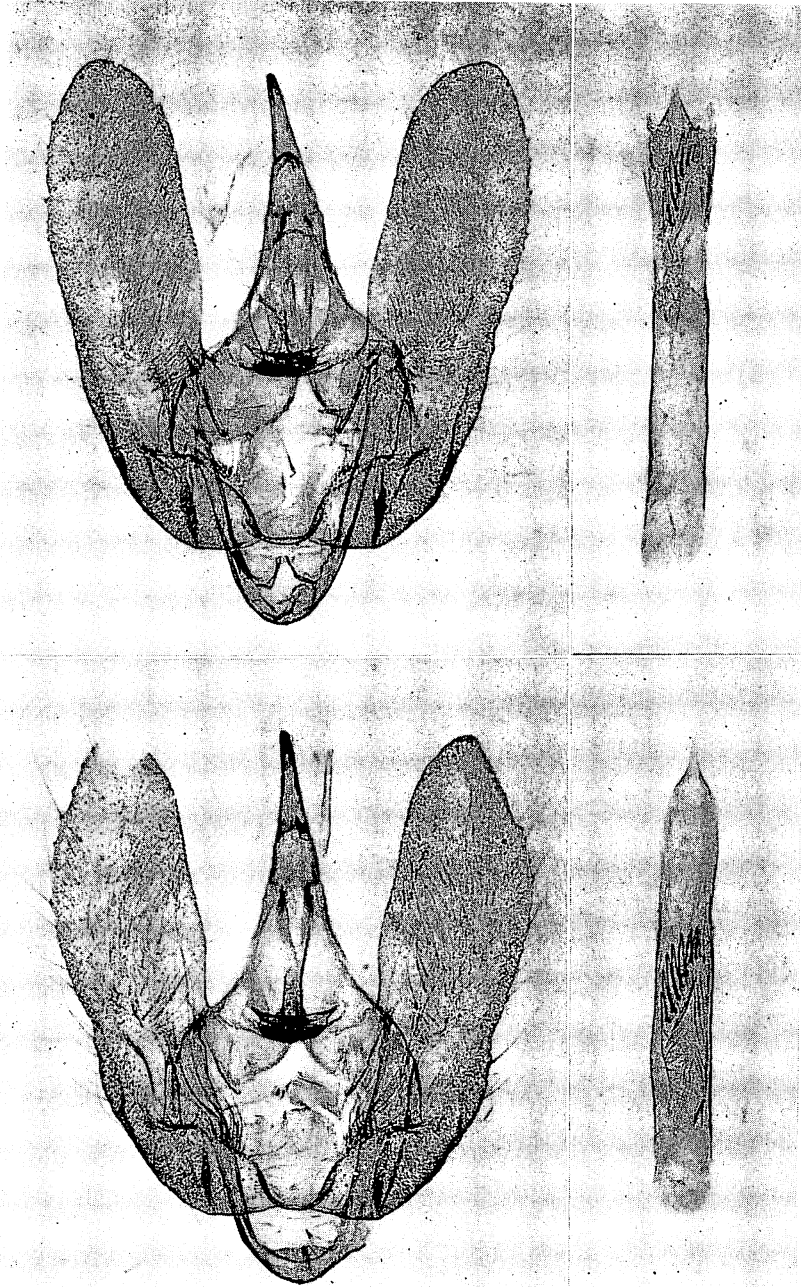


Figure 61—Male genitalia of *Scotorythra goniastis* Meyrick, lectotype from Hawaii, above. Below, an example from Oahu. Note the different positions of the spines on the internal sacs in the two examples; that of the upper figure is partly extruded.

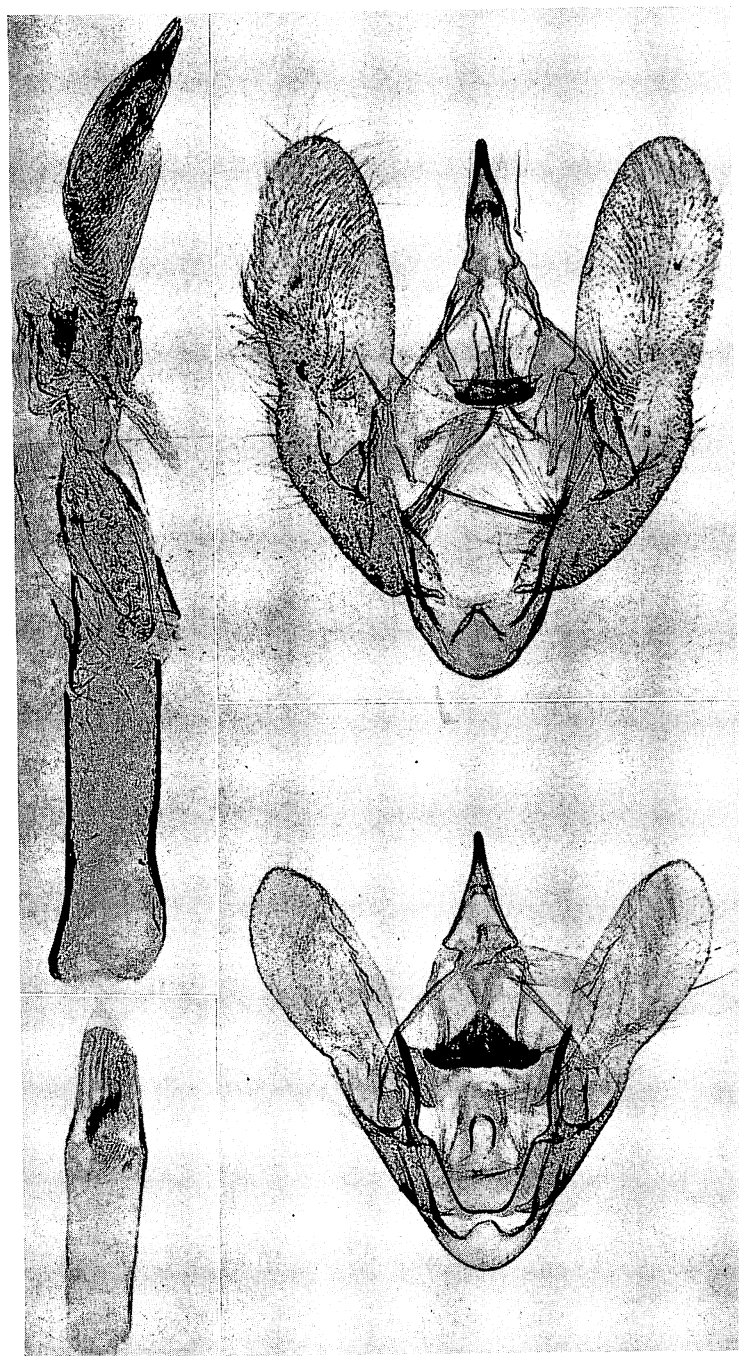


Figure 62—Above: Male genitalia of *Scotorythra hecataea* Meyrick; northwestern Koolau Mts., Oahu. Below: The type of *hyparcha* Meyrick; Kilauea, Hawaii.



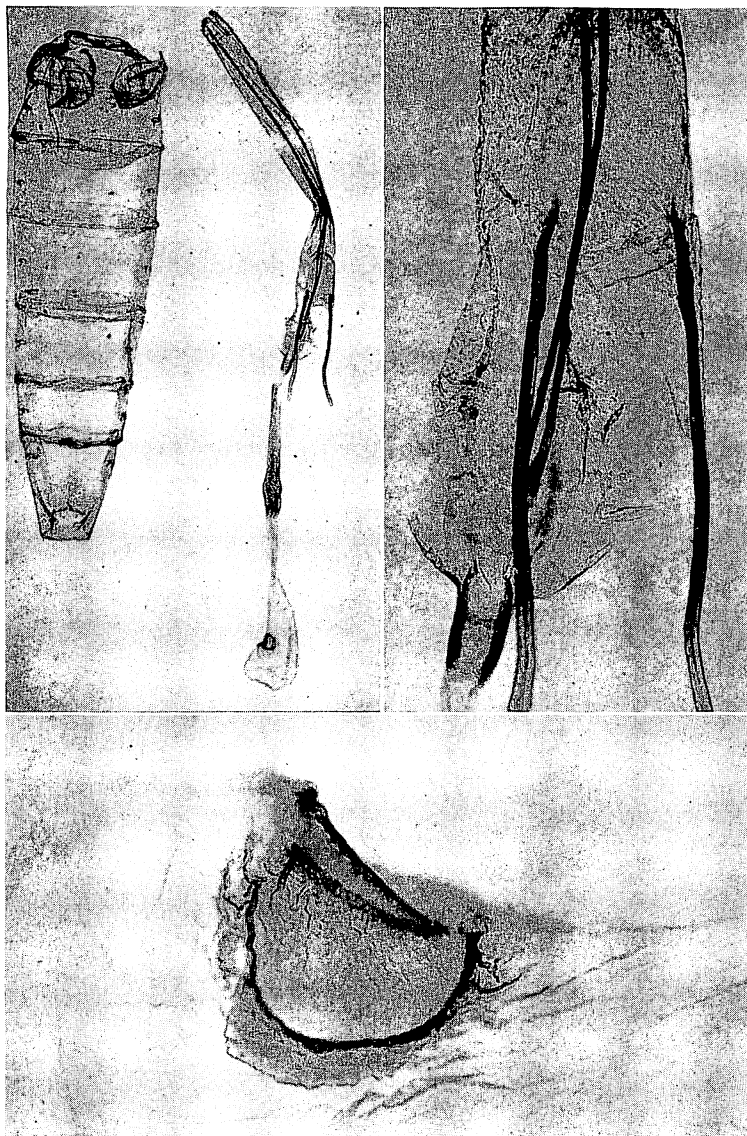


Figure 63—Female genitalia of *Scotorythra goniastis* Meyrick; Kilauea, Hawaii.

**Scotorythra goniastis** Meyrick (figs. 60, 61, 63, 106).

*Scotorythra goniastis* Meyrick, 1899:180; 1900:258.

Endemic. Maui? (type locality: Haleakala?), Hawaii.

Hostplant: Unknown.

This species was described from a male and a female collected by Blackburn. The female was improperly associated with the male, and it belongs to *diceraunia*. Meyrick did not label his type, and I have designated it as lectotype in the British Museum. It bears the label "Hawaiian Is. T.B./82," but the exact place where it was collected is not known.

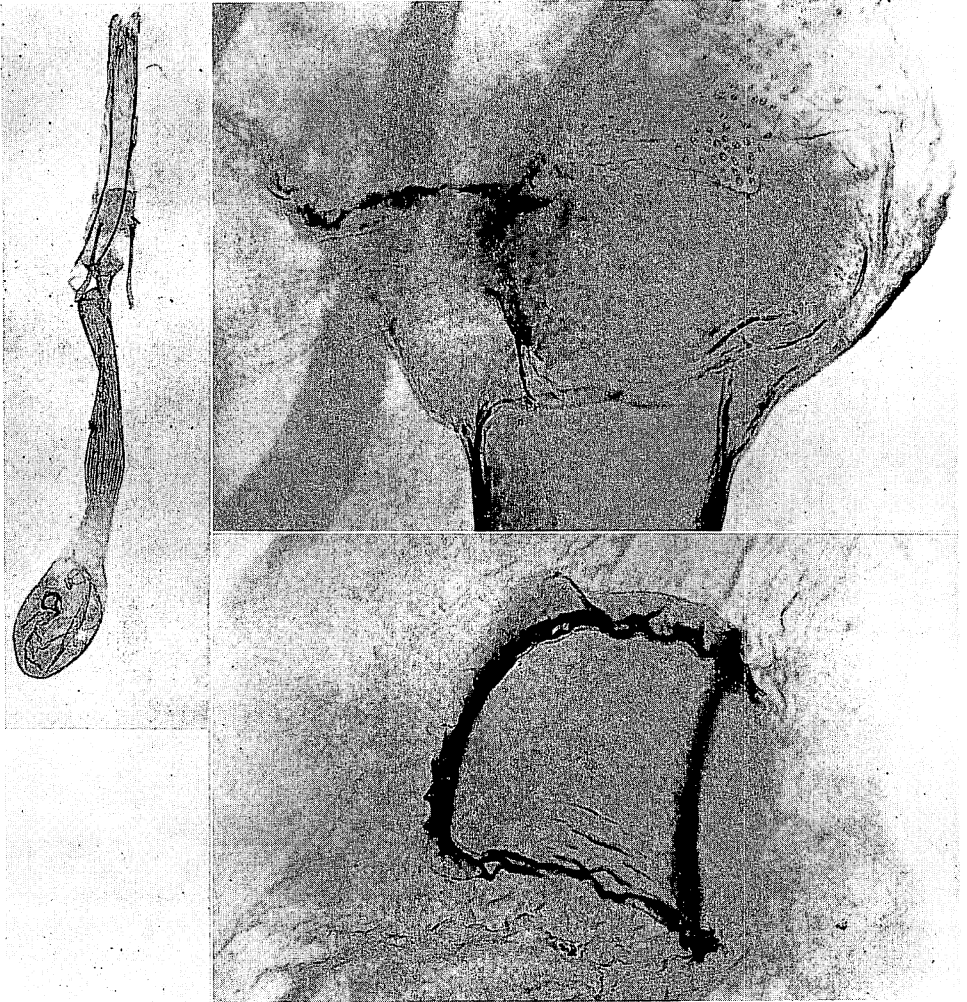


Figure 64—Female genitalia of the type of *Scotorythra hecataea* Meyrick; Waimea Mts., Kauai, 4,000 feet.



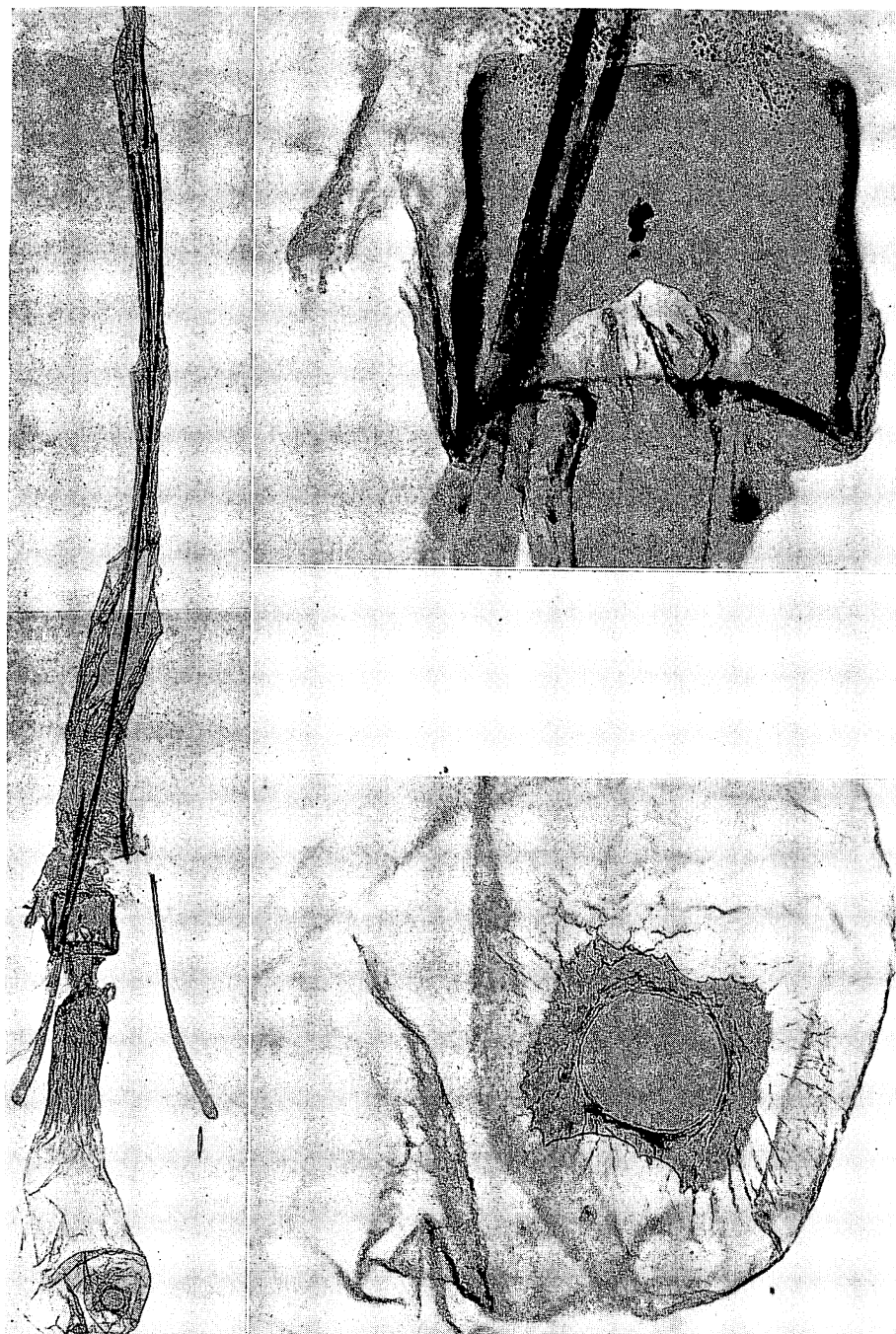


Figure 65—Female genitalia of *Scotorythra hyparcha* Meyrick; Kilauea, Hawaii.

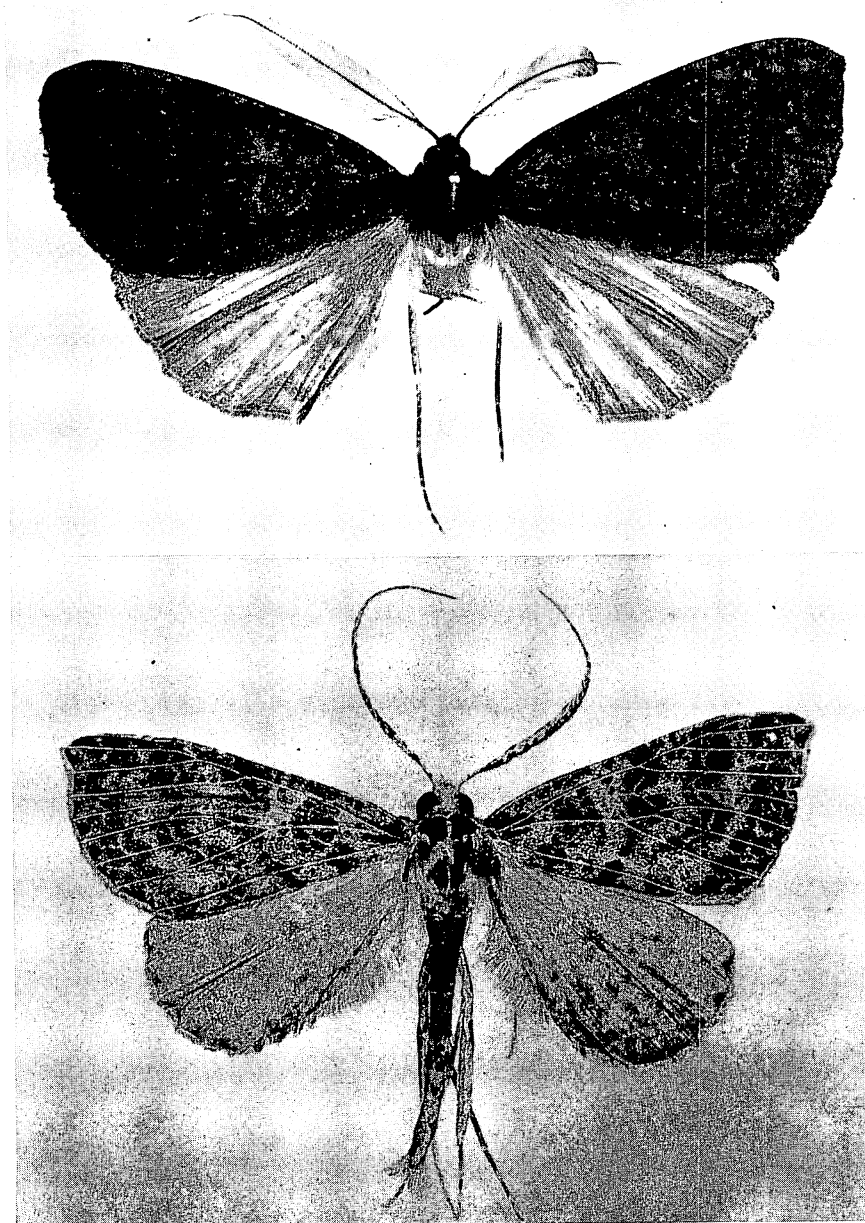


Figure 66—Above: *Scotorythra hyparcha* Meyrick, male type; expanse, 60 mm.; Kilauea, Hawaii (the antemedial lines are poorly defined in this photograph). Below: The male type of *kuschei* Swezey; Kauai; expanse, 37 mm.

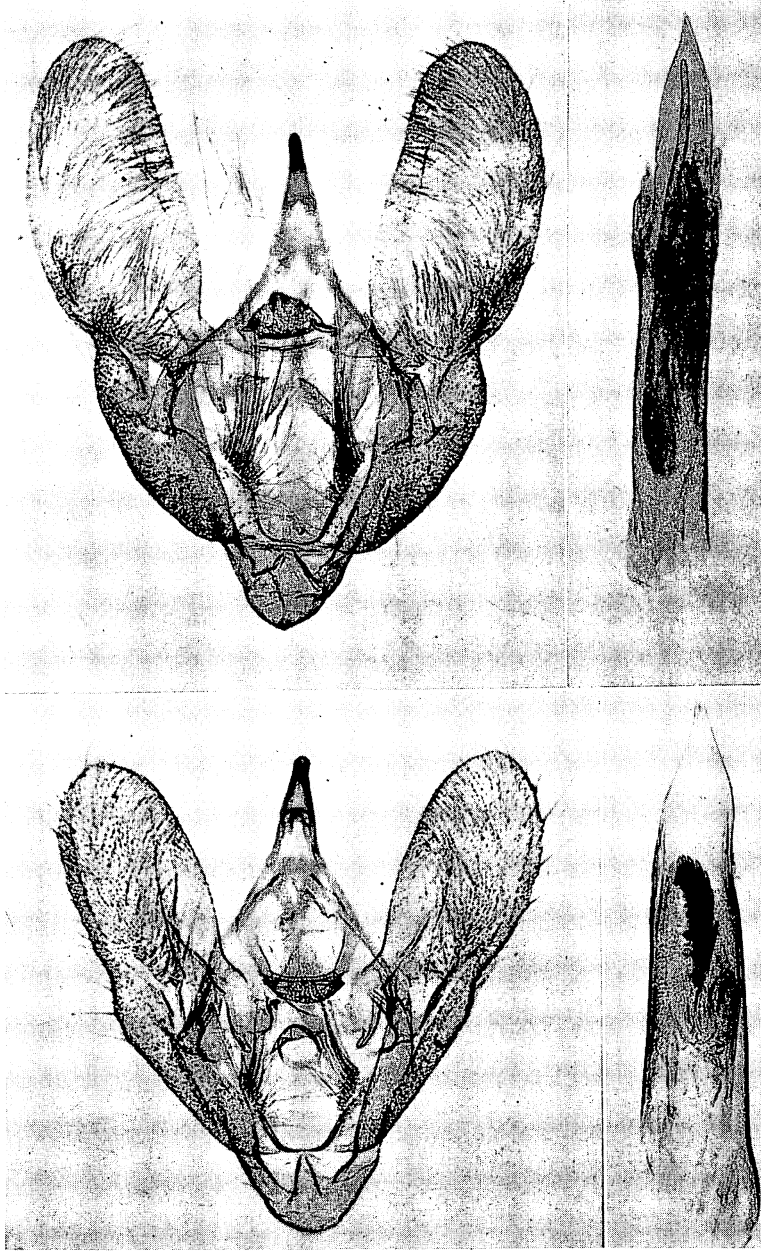


Figure 67—Above: Male genitalia of *Scolorythra kuschei* Swezey, type; Kauai (base of aedeagus broken). Below: Of type of *leptias* Meyrick; northwestern Koolau Mts., Oahu.

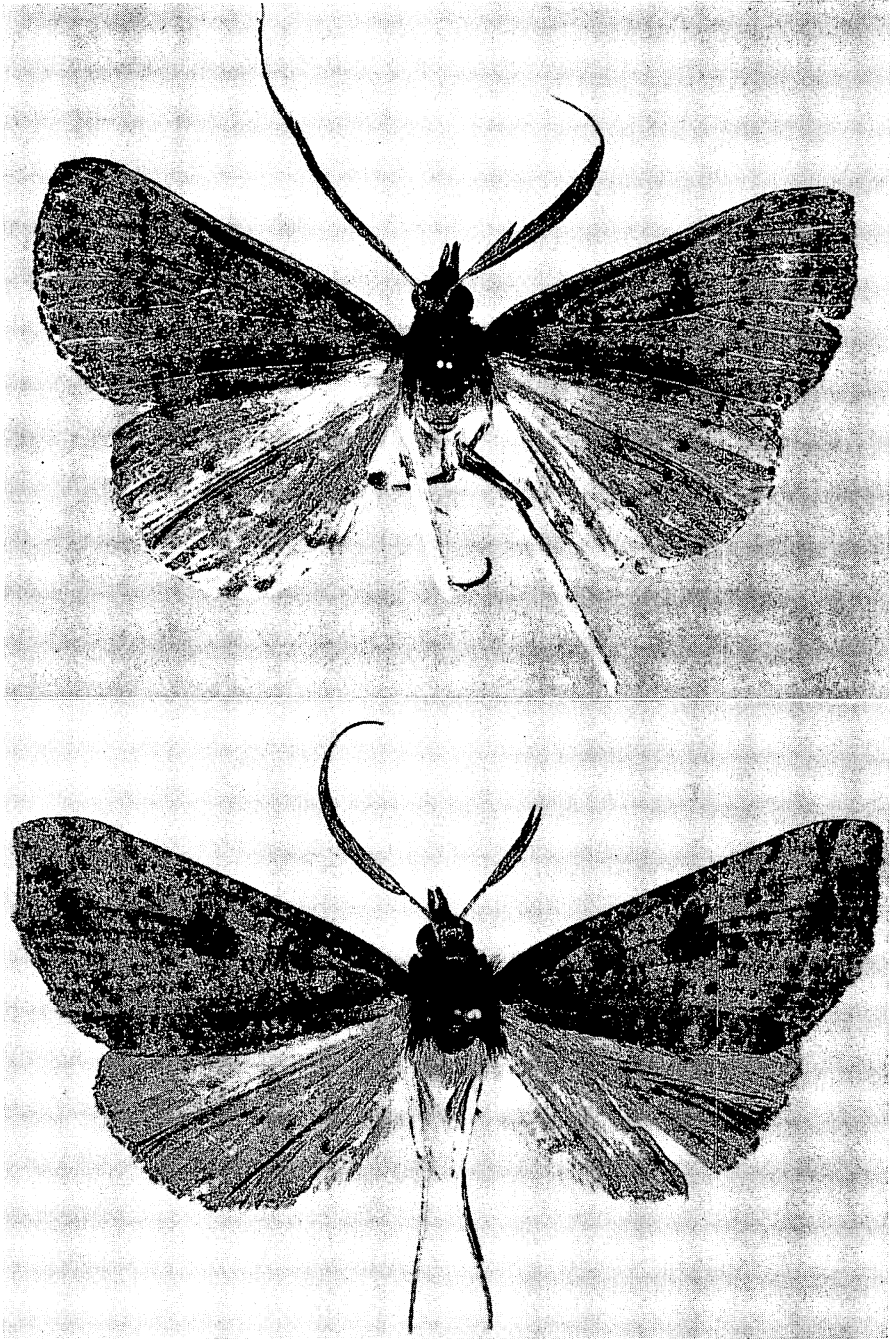


Figure 68—Above: *Scotothyra leptias* Meyrick, male type; northwestern Koolau Mts., Oahu; expanse, 34 mm. Below: The male type of *macrosoma* Meyrick; Olaa, Hawaii; expanse, 40 mm.; (the abdomen was 20 mm. long on this example).

**Scotorythra hecataea** Meyrick (figs. 60, 62, 64, 106).

*Scotorythra hecataea* Meyrick, 1899:177; 1904:351.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet), Oahu.

Hostplant: Unknown.

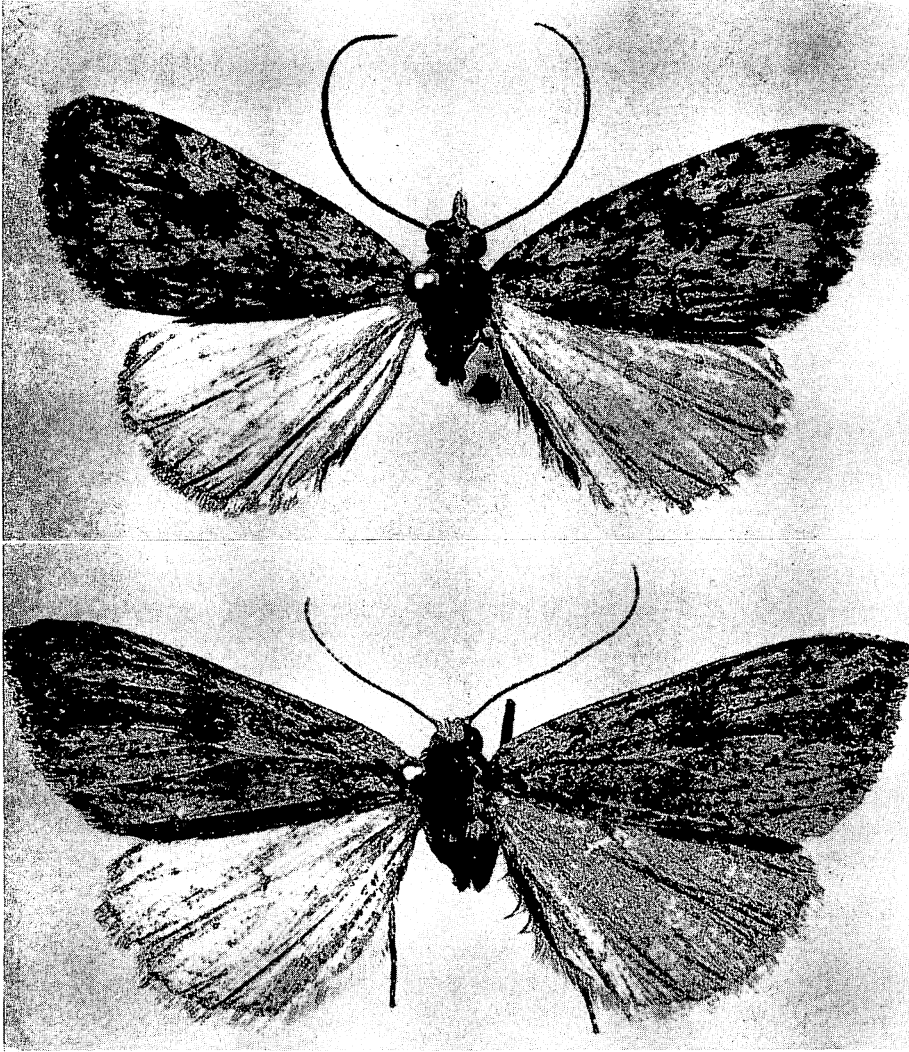


Figure 69—Above: *Scotorythra melacrossa* Meyrick, male type; southeastern Koolau Mts., Oahu; expanse, 25 mm.; (antennae viewed on edge and pectinations not visible). Below: a female *melacrossa* Meyrick; southeastern Koolau Mts., Oahu; expanse, 31 mm.



**Scotorythra hyparcha** Meyrick (figs. 62, 65, 66).

*Scotorythra hyparcha* Meyrick, 1899:189.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Probably *Metrosideros*.

Parasite: *Enicospilus tyrannus* Perkins.

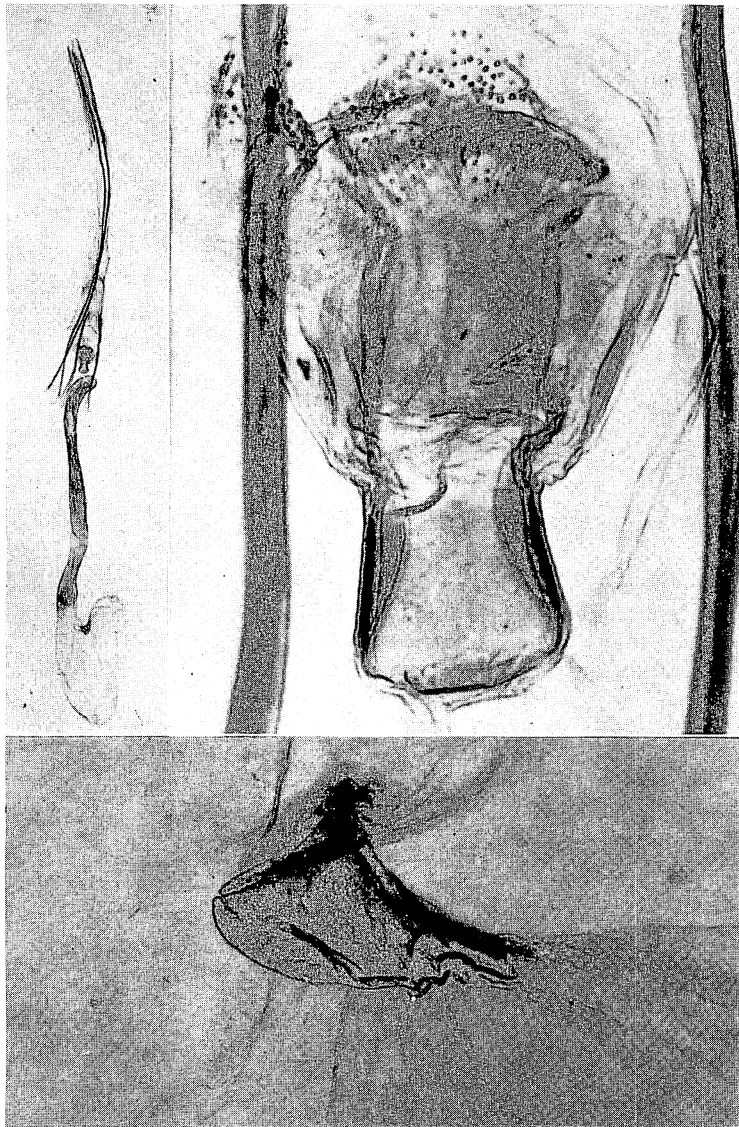


Figure 70—Female genitalia of *Scotorythra leptias* Meyrick; Kona, Hawaii.

A large collection of specimens reveals the females to be very variable, but the males are nearly constant in markings. It is one of the largest geometrids in Hawaii, and it often occurs in very large numbers. Giffard (*Proc. Hawaiian Ent. Soc.* 5(2):196, 1923) "remarked on the overabundance of this nocturnal moth at lights in Kilauea region for the past four or five months. The verandahs and porches of the Volcano House and residences in the neighborhood have been overrun by this moth, possibly 90 per cent of the number seen nightly being males. At the hotel, the nightly flight was so annoying to guests that the servants were called to use the vacuum cleaner to sweep the ceilings and walls free from these pests."

It was surprising to me to find the male genitalia of this species so much like those of *epixantha*. The subbasal patch of abdominal spines of the male is absent in that species.

**Scotorythra kuschei** Swezey (figs. 66, 67, 106).

*Scotorythra kuschei* Swezey, 1940:461.

Endemic. Kauai (type locality: "High Plateau").

Hostplant: Unknown.

**Scotorythra leptias** Meyrick (figs. 67, 68, 70, 106).

*Scotorythra leptias* Meyrick, 1904:354.

Endemic. Oahu (type locality: northwest Koolau Mountains).

Hostplant: Unknown.

The male holotype is much like *brunnea*, and it may only be a form or subspecies of that species. None of a long series of male *brunnea* examined has the costa of the fore wing pale yellowish as it is on *leptias*, but I have seen two females of *brunnea* from Hawaii on which it is yellow. As Meyrick states, the 36 mm. expanse of this form is considerably smaller than the males of *brunnea*, which range from 40 to 45 mm. It also resembles *paludicola*.

**Scotorythra macrosoma** Meyrick (figs. 68, 71, 72, 107).

*Scotorythra macrosoma* Meyrick, 1899:185, pl. 5, fig. 2.

Endemic. Kauai, Molokai, Maui, Hawaii (type locality: Olaa).

Hostplant: Reared from leaves of *Ricinus*, but native hostplant unknown.

**Scotorythra metacrossa** Meyrick (figs. 69, 71, 73).

*Scotorythra metacrossa* Meyrick, 1904:352.

Endemic. Oahu (type locality: southeast Koolau Mountains).

Hostplant: *Acacia koa* (see Perkins, quoted in Swezey, 1954:3).

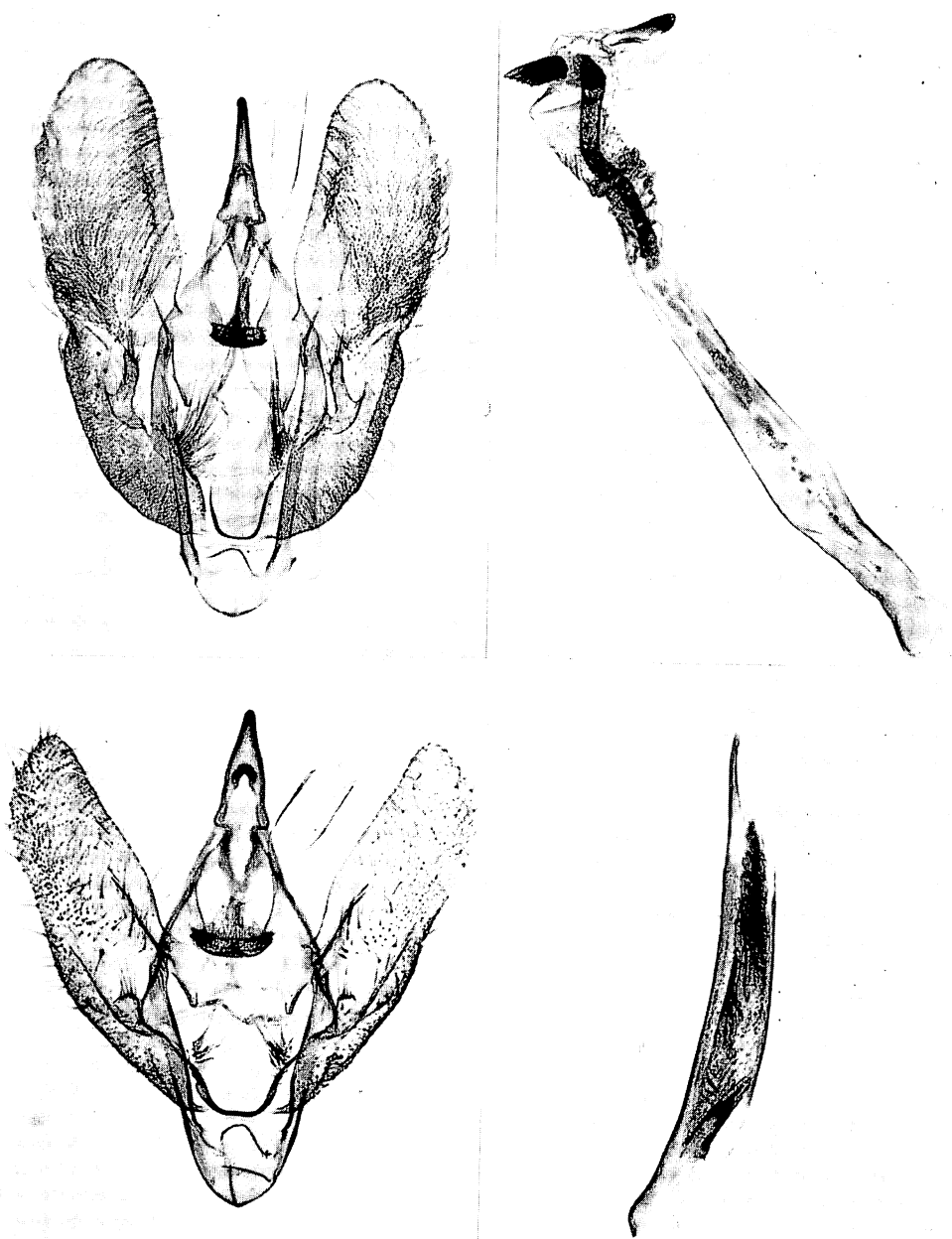


Figure 71—Above: Male genitalia of *Scotorythra macrosoma* Meyrick, type; Olaa, Hawaii; internal sac extruded. Below: The type of *metacrossa* Meyrick; southeastern Koolau Mts., Oahu.



**Scotorythra nephelosticta nephelosticta** Meyrick (figs. 74, 75, 76, 107).

*Scotorythra nephelosticta* Meyrick, 1899:183.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: Unknown.

This is so much like *capnopa* that it may only be a subspecies of that form. The genitalia are closely similar.

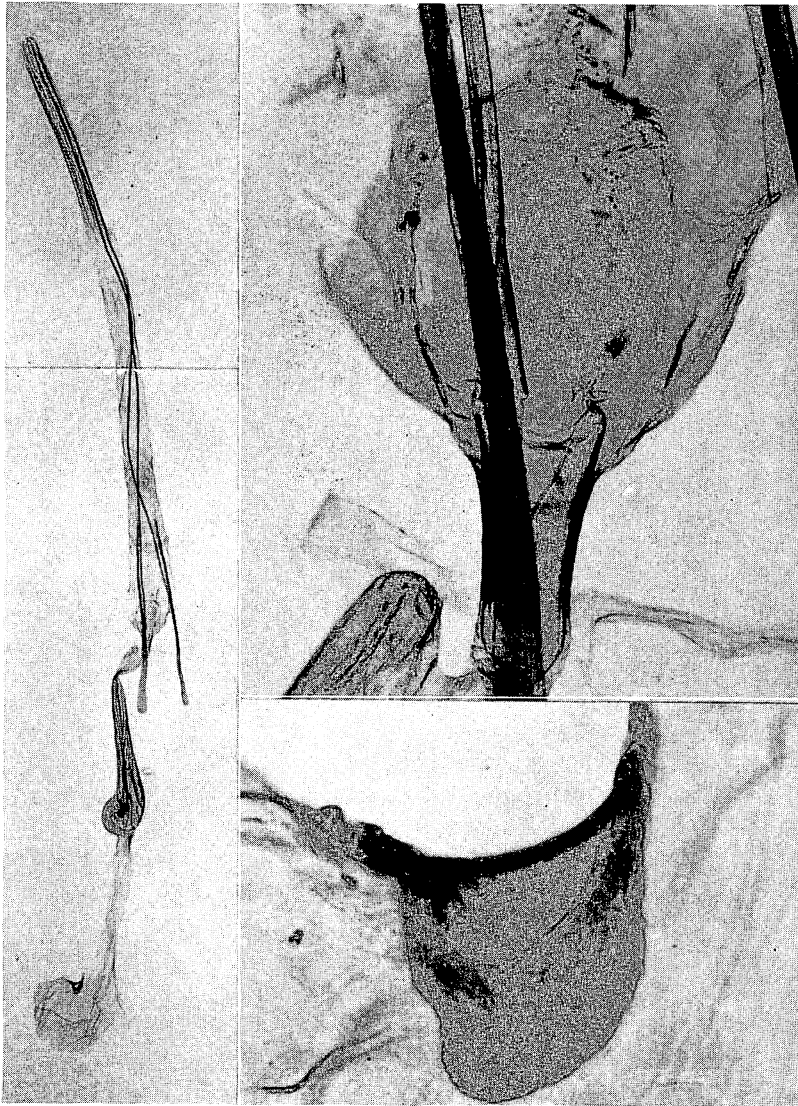


Figure 72—Female genitalia of *Scotorythra macrosoma* Meyrick; Olaa, Hawaii; total length, 25 mm.

**Scotorythra nephelosticta cocytias** Meyrick (figs. 74, 75, 107).

*Scotorythra nephelosticta* geographical race *cocytias* Meyrick, 1904:353.

Endemic. Oahu (type locality: northwest Koolau Mountains).

Hostplant: Unknown.

Meyrick considered the Oahu specimens to represent a race which he characterized as follows: "Smaller and darker than type, forewings almost wholly

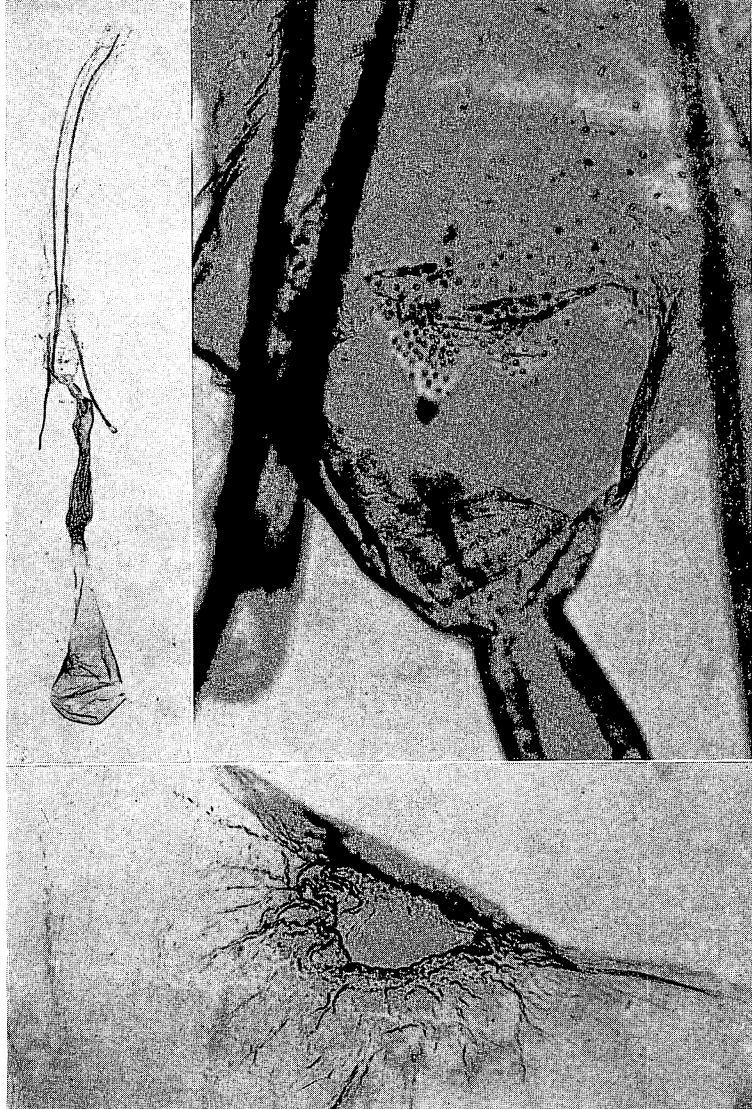


Figure 73—Female genitalia of *Scotorythra metacrossa* Meyrick; southeastern Koolau Mts., Oahu.

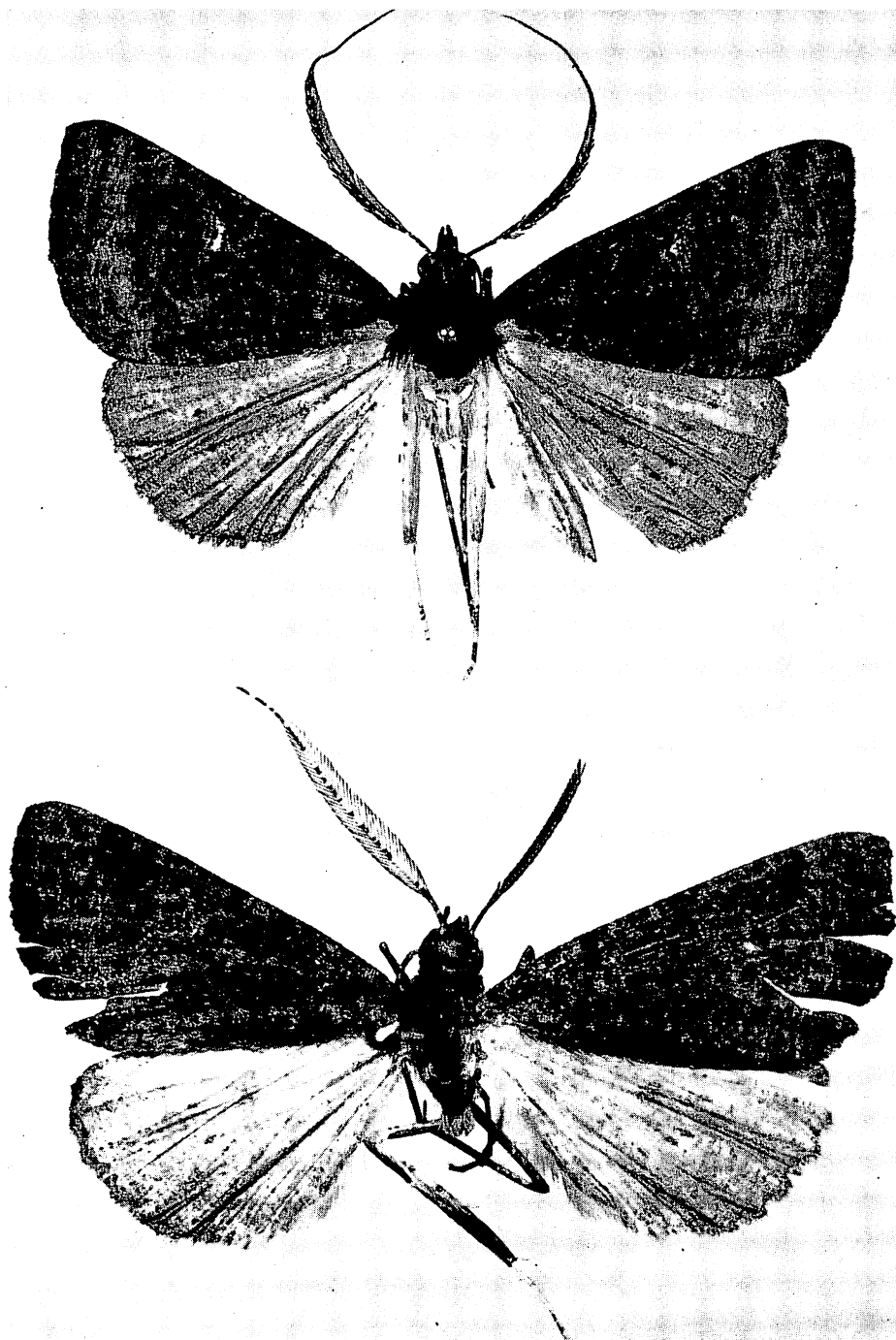


Figure 74—Above: *Scotorythra nephelosticta* Meyrick, male type; Kaholuamano, Kauai, 4,000 feet; expanse, 39 mm. Below: *nephelosticta cocytias* Meyrick, male; northwestern Koolau Mts., Oahu; expanse, 29 mm.

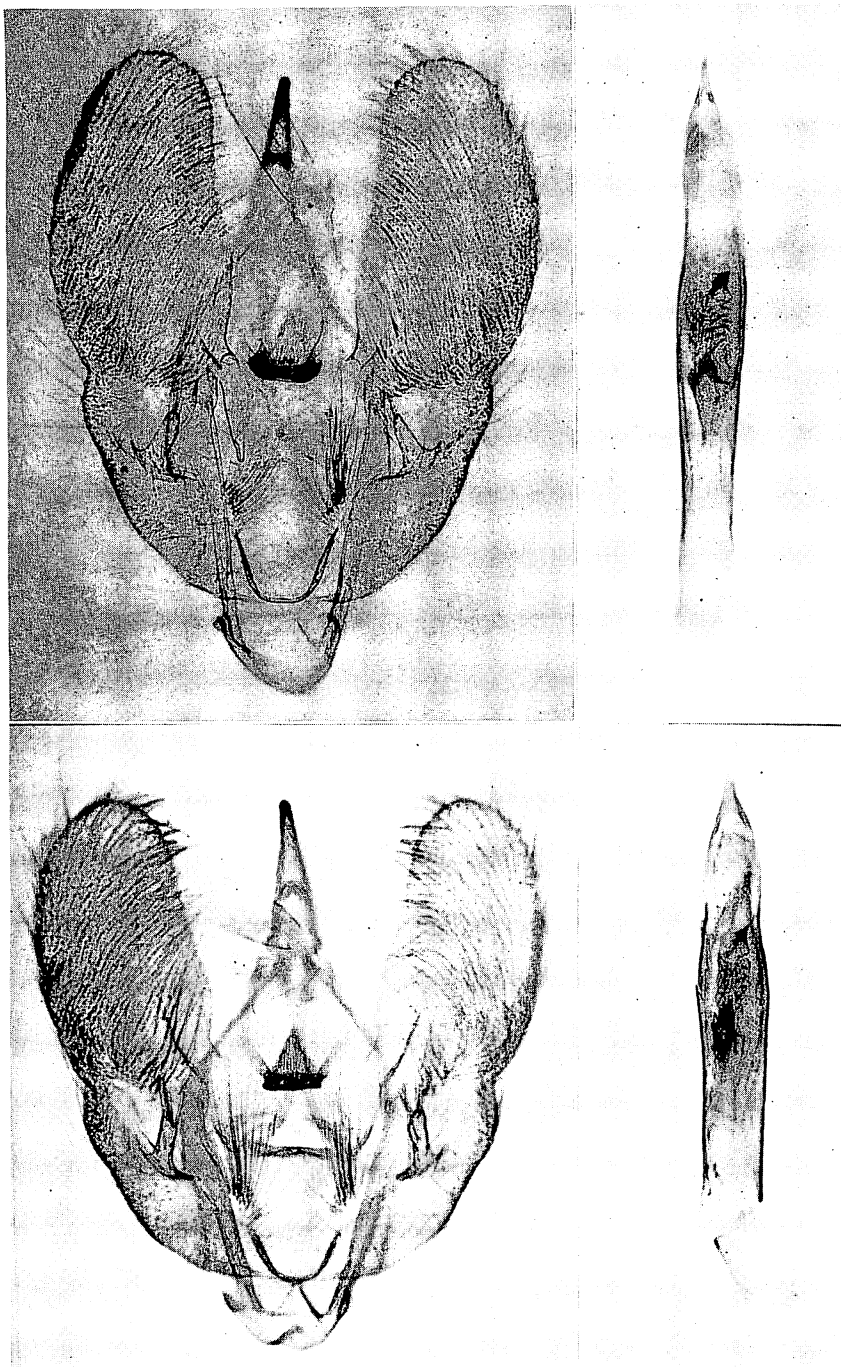


Figure 75—Above: Male genitalia of the type of *Scotorythra nephelosticta* Meyrick; Kaholua-mano, 4,000 feet, Kauai. Below: Of *nephelosticta cocytias* Meyrick; northwestern Koolau Mts., Oahu.



Figure 76—Female genitalia of *Scotorythra nephelosticta* Meyrick; Oahu.

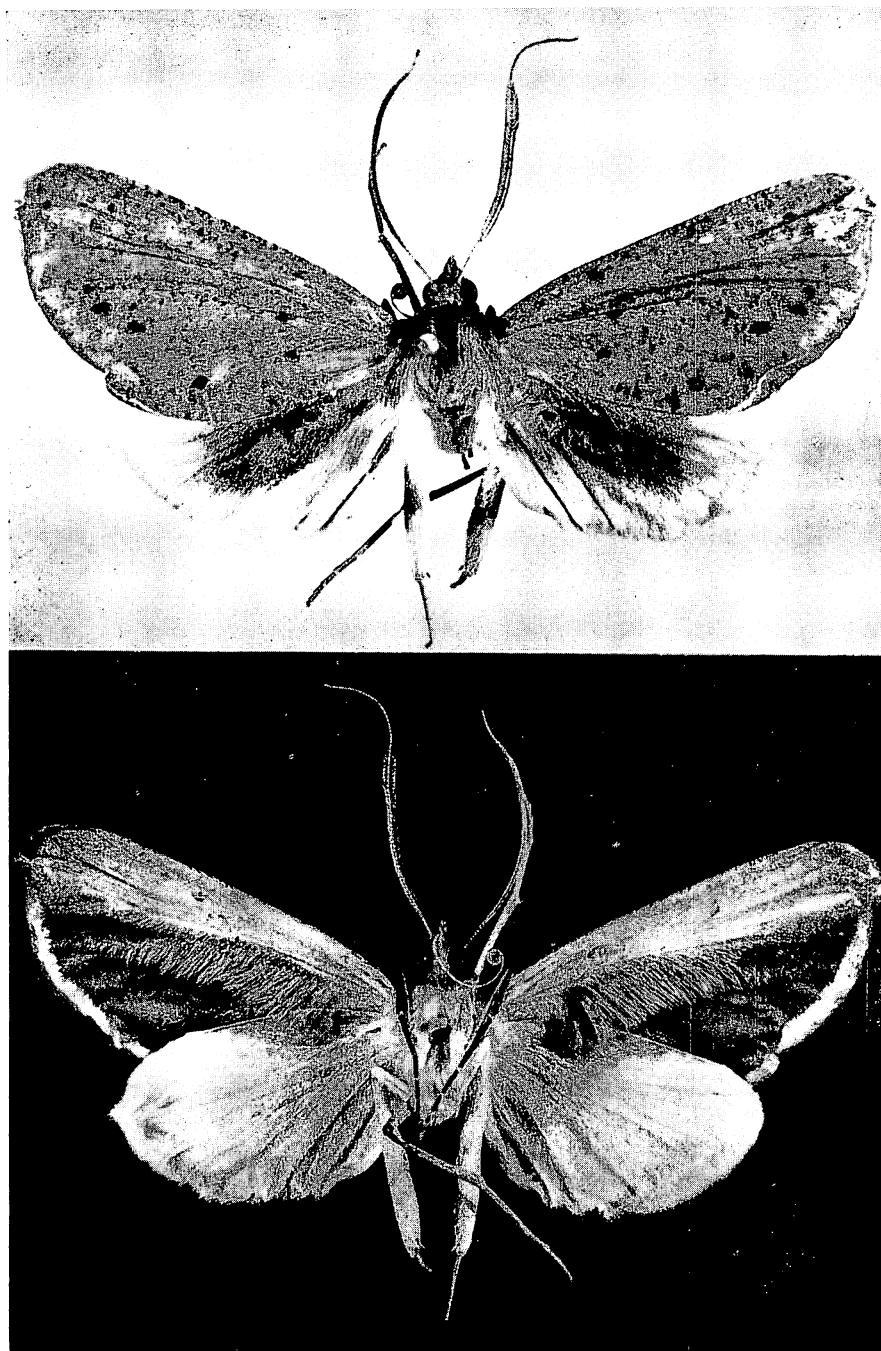


Figure 77— Dorsal and ventral views of the male type of *Scotorythra ochetias* (Meyrick); Olaa, Hawaii, 2,000 feet; expanse, 49 mm. The erect hairs on the upper surfaces of the hind wings are not well shown in the photograph.

suffused with dark fuscous, but the two brownish bands usually perceptible; discal spot often obsolete, but in one specimen white, pearshaped." This may not be a good subspecies.

**Scotorythra ochetias** (Meyrick), **new combination** (figs. 77, 78, 79, 80, 107).  
*Sisyrophyta ochetias* Meyrick, 1899:169.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: Unknown.

I have removed this remarkable species and its ally *gomphias* from Meyrick's genus. Further discussion may be found under the latter species, under the generic heading, and in the key to species.

**Scotorythra ortharcha** Meyrick (figs. 79, 81, 83).  
*Scotorythra ortharcha* Meyrick, 1899:181, pl. 5, fig. 1.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: Unknown.

**Scotorythra oxyphractis** Meyrick (figs. 82, 84, 86, 107).  
*Scotorythra oxyphractis* Meyrick, 1899:181; 1904:352.

Endemic. Kauai, Oahu, Molokai, Hawaii (type locality: Olaa).

Hostplant: Unknown.



Figure 78—*Scotorythra ochetias* (Meyrick), female; Olaa, Hawaii; expanse, 47 mm.



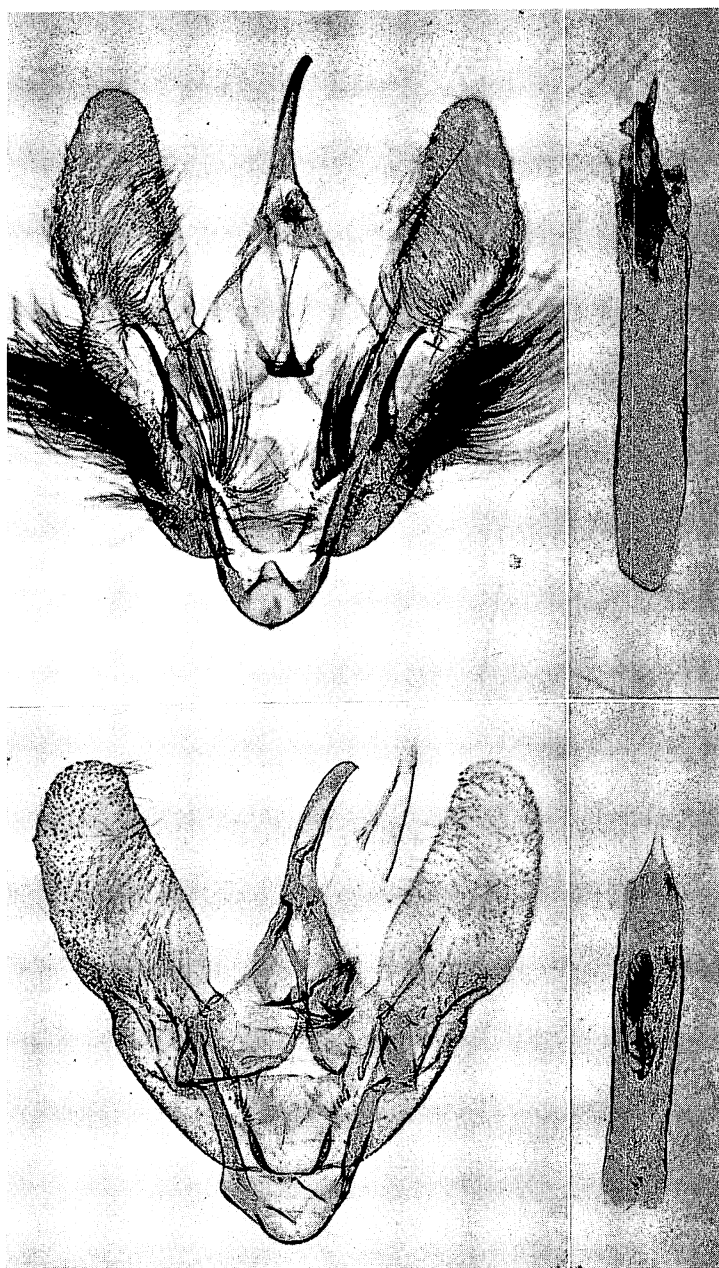


Figure 79—Above: Male genitalia of *Scotorythra ochetias* (Meyrick), type; Olaa, Hawaii. Below: Of the type of *ortharcha* Meyrick; Olaa, Hawaii.





Figure 80—Female genitalia of *Scotorythra ochetias* (Meyrick); Oloo, Hawaii.

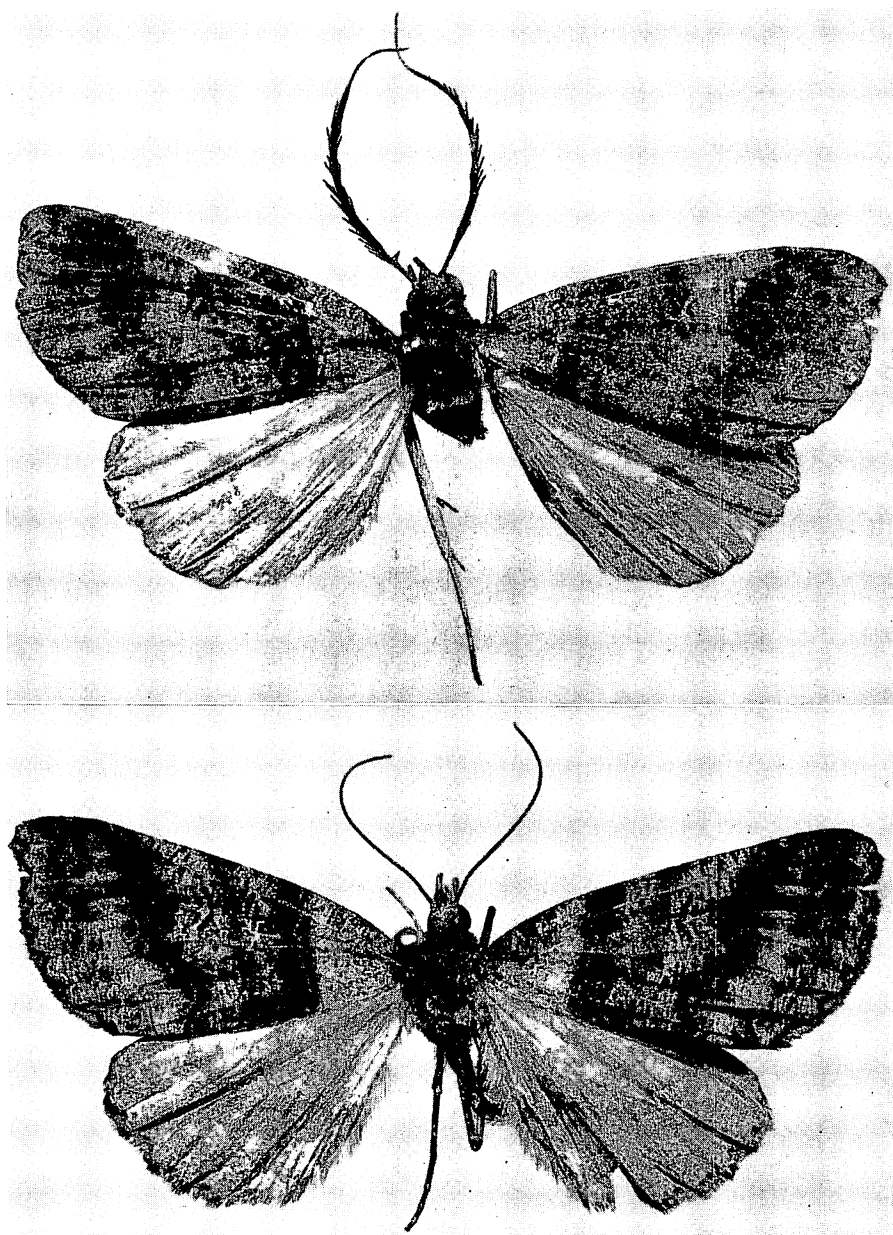


Figure 81—Above: *Scotorythra ortharcha* Meyrick, male type; Olaa, Hawaii; 2,000 feet; expanse, 32 mm. Below: *ortharcha*, female; from the same locality; expanse, 35 mm.

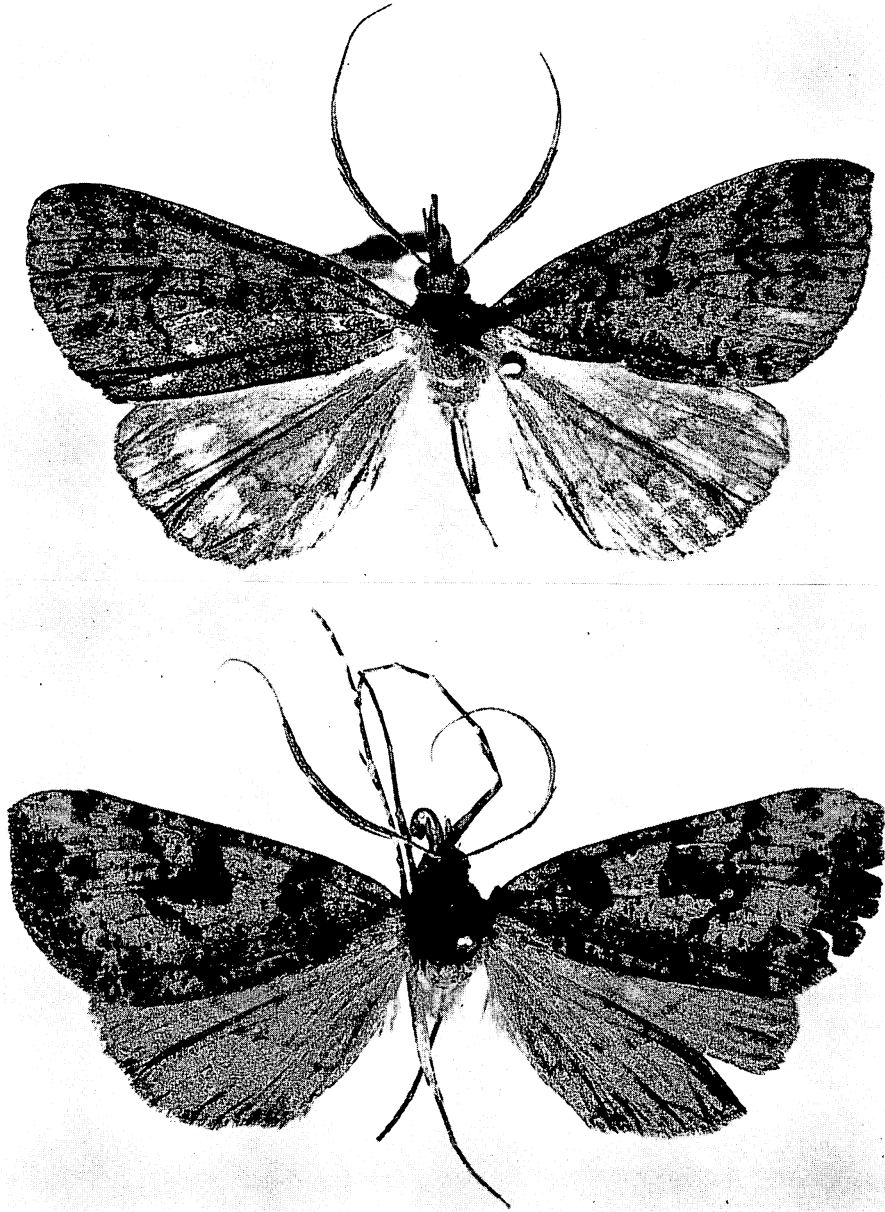


Figure 82—Above: *Scolorythra oxyphractis* Meyrick, male type; Olaa, Hawaii; expanse, 35 mm.  
Below: The male type of *pachyspila* Meyrick; Haleakala, Maui, 5,000 feet; expanse, 41 mm.

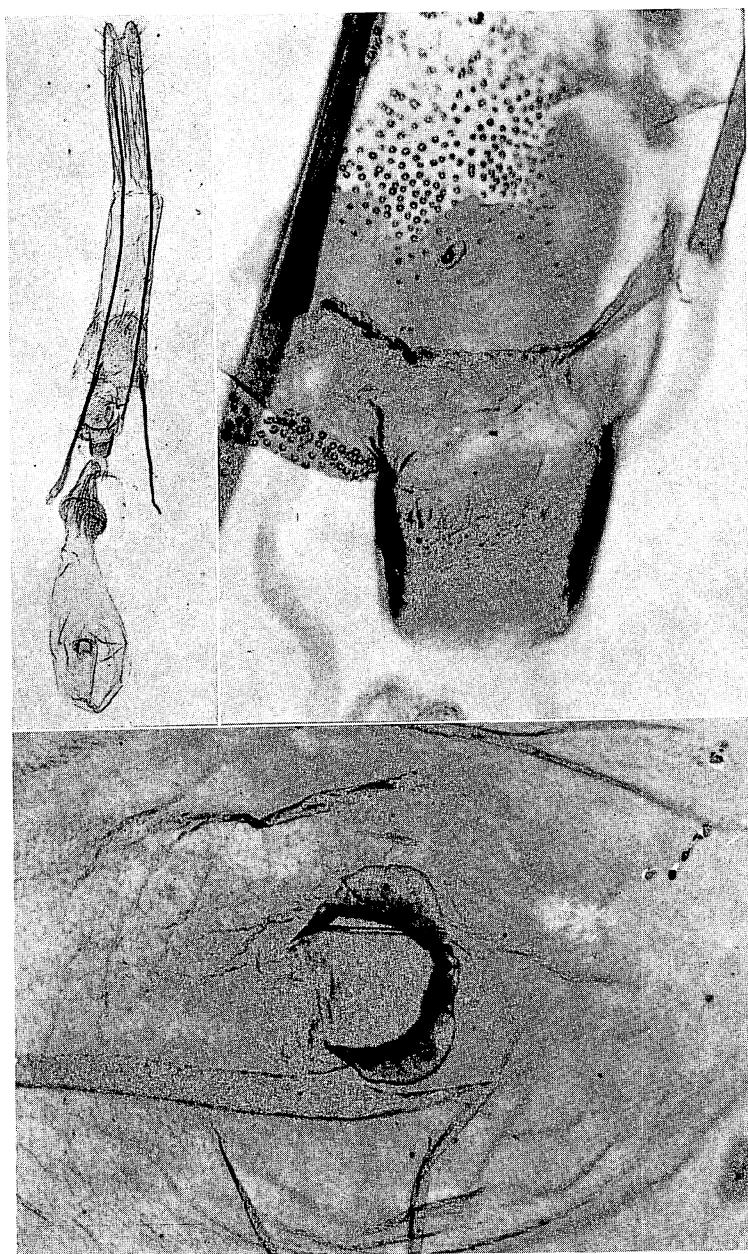


Figure 83—Female genitalia of *Scotorythra ortharcha* Meyrick; Olaa, Hawaii.

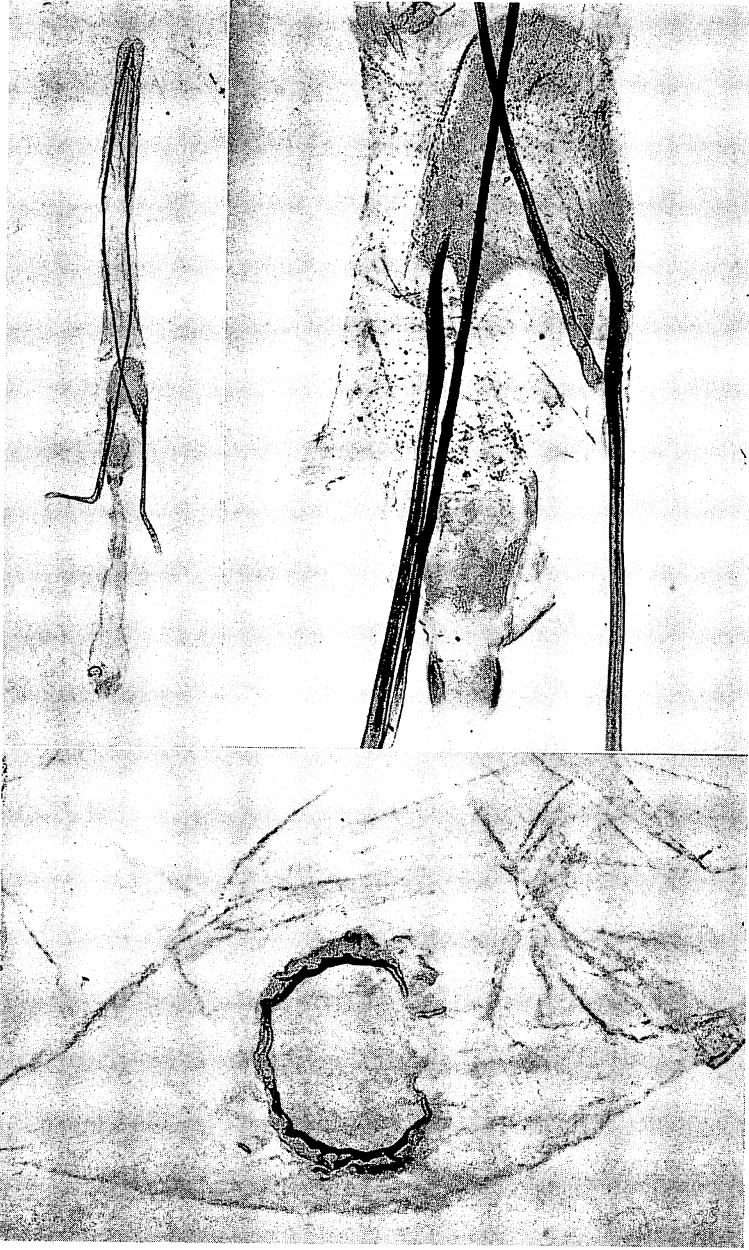


Figure 84—Female genitalia of *Scolorythra oxyphractis* Meyrick; Olaa, Hawaii.

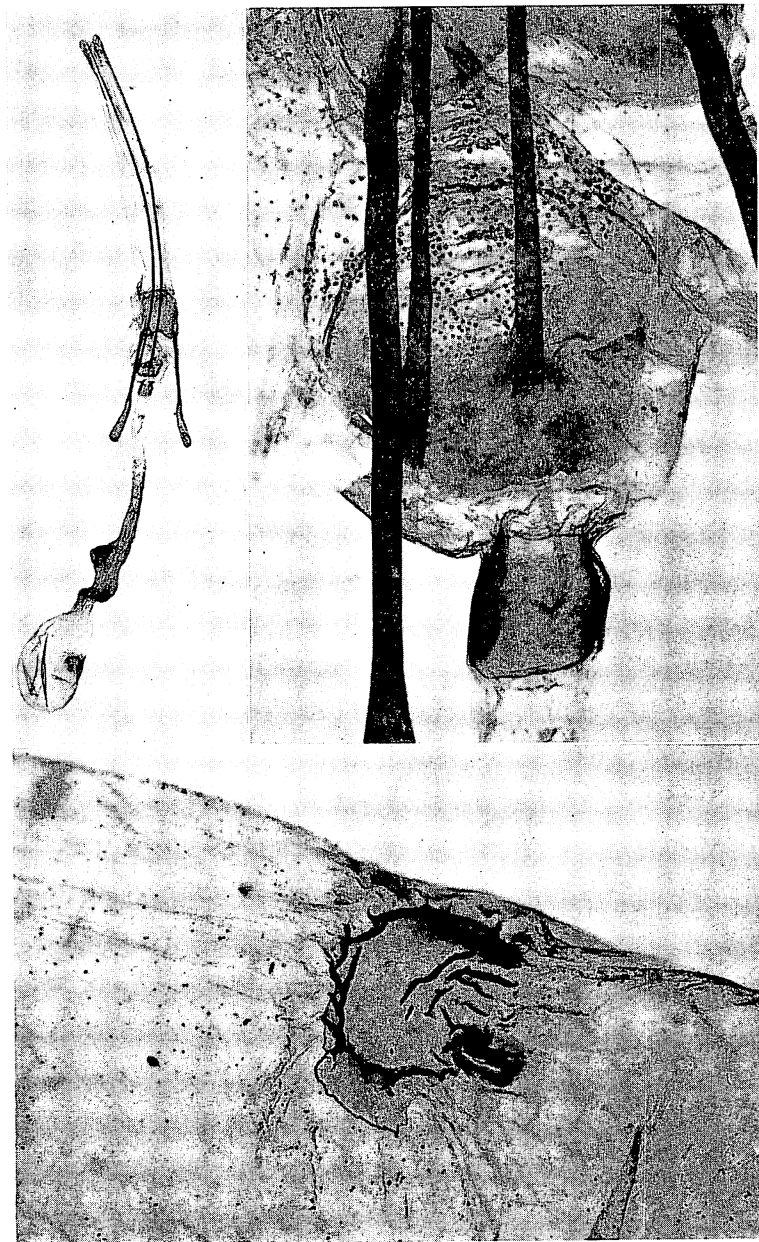


Figure 85—Female genitalia of *Scotorythra pachyspila* Meyrick; Olaa, Hawaii.



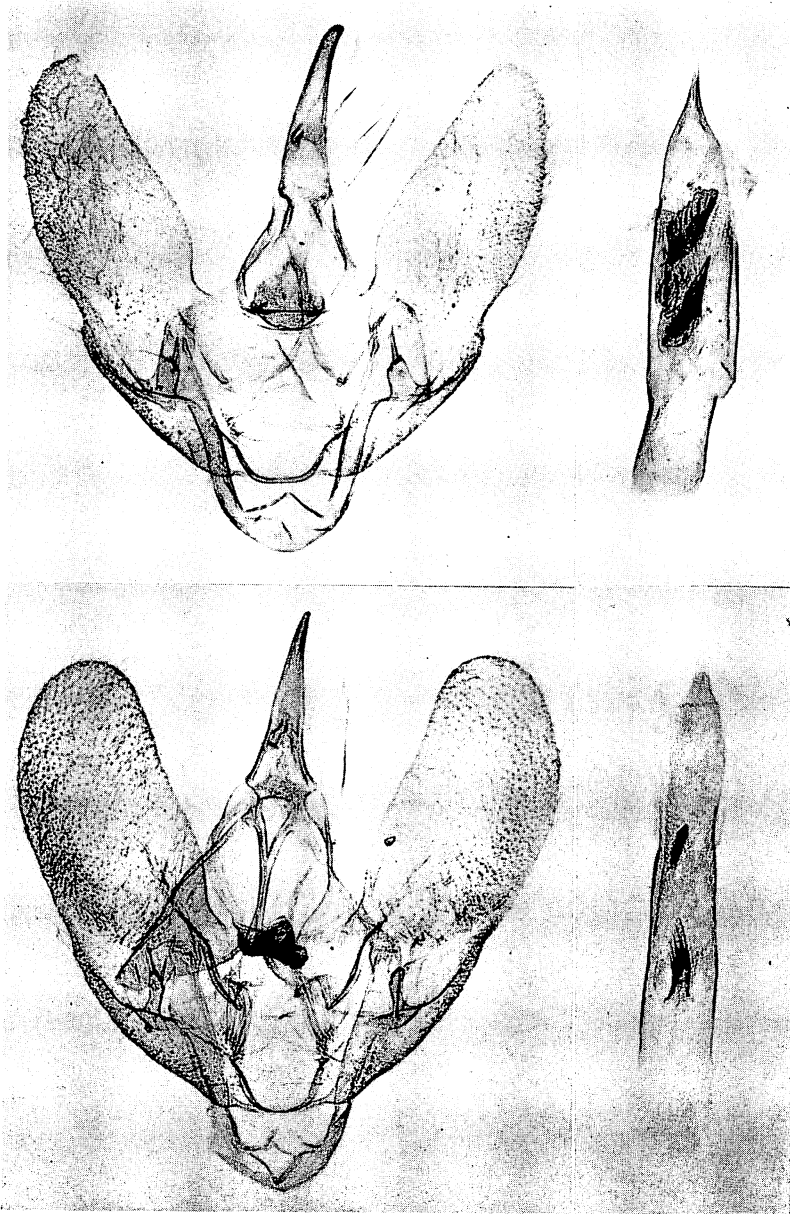


Figure 86—Above: Male genitalia of *Scotorythra oxyphractis* Meyrick, type; Olaa, Hawaii.  
Below: Of type of *pachyspila* Meyrick; Haleakala, Maui.

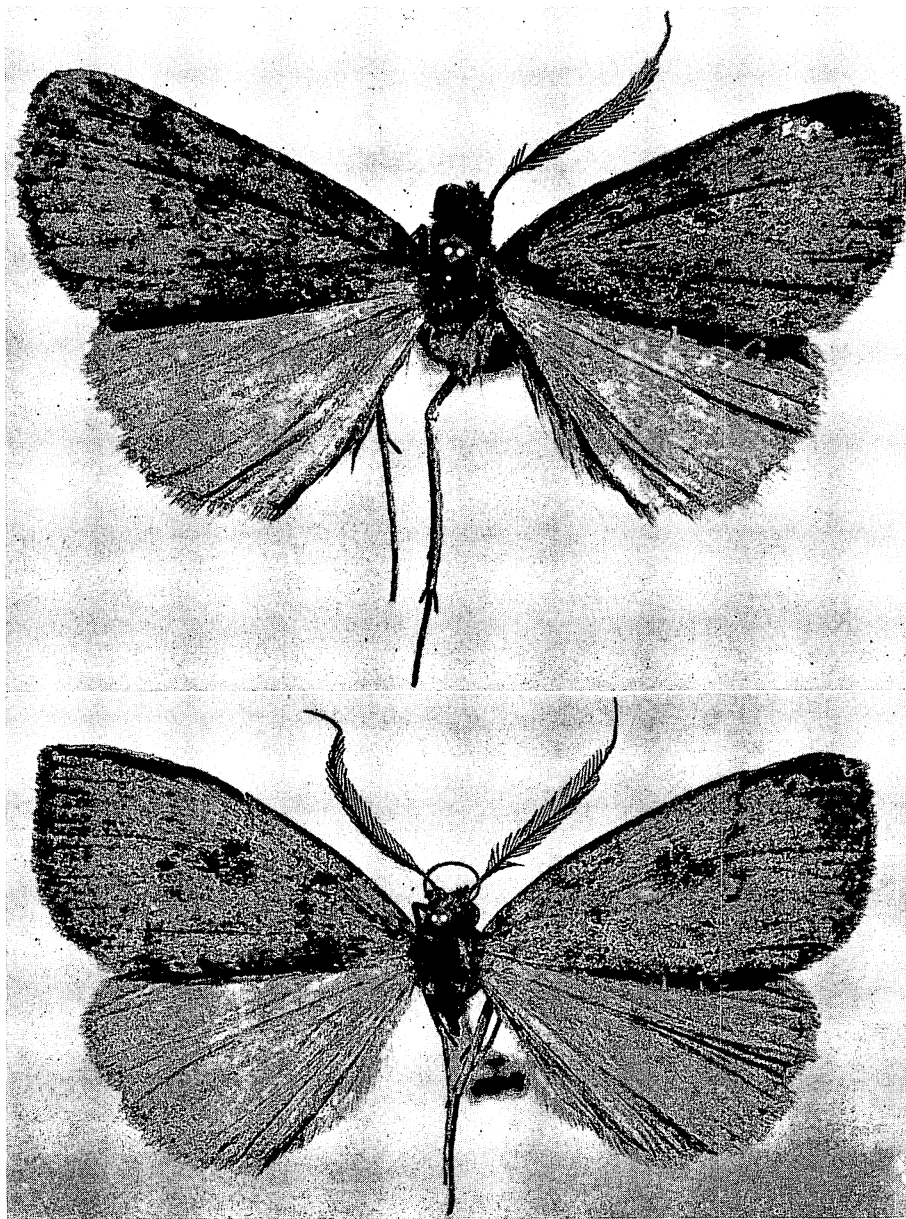


Figure 87—Above: *Scotorythra paludicola* (Butler), male type; "Sandw. Isl. 79-8 No. 58"; expanse, 26 mm. Below: The male type of *idolias* Meyrick, a synonym of *paludicola*; Kilauea, Hawaii; expanse, 32 mm.



**Scotorythra pachypila** Meyrick (figs. 82, 85, 86, 107).

*Scotorythra pachypila* Meyrick, 1899:185, pl. 3, figs. 4, 4a-d; 1904:353.

Endemic. Kauai, Oahu, Maui (type locality: Haleakala, 5,000 feet), Lanai, Hawaii.

Hostplant: *Metrosideros*.

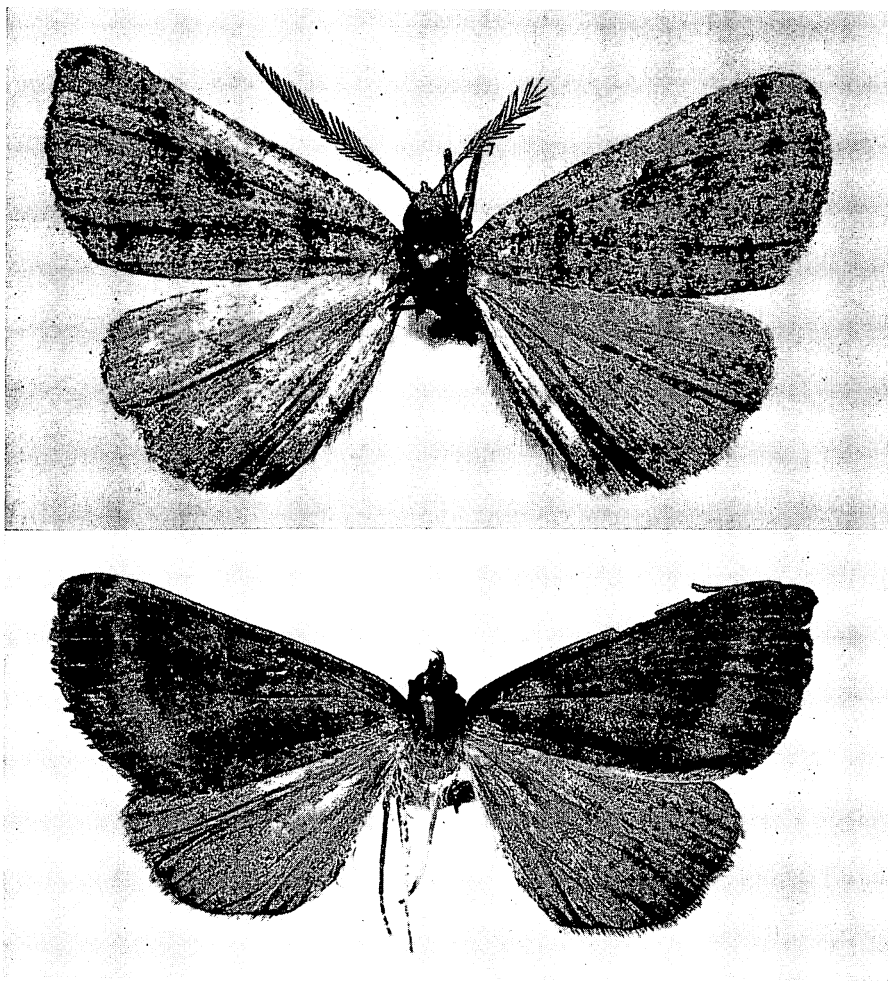


Figure 88—Above: *Scotorythra paratactis* Meyrick, male type; Waianae Coast, Oahu; expanse, 23.5 mm. Below: The male type of *platycapna* Meyrick; Waimea Mts., Kauai, 4,000 feet; expanse, 46 mm.

**Scotorythra paludicola** (Butler) (figs. 87, 89, 90, 108).

*Pseudocoremia paludicola* Butler, 1879:272.

*Scotorythra paludicola* (Butler) Meyrick, 1899:179. Swezey, 1954:1, 3, fig. 1, variation in adults.

*Scotorythra idolias* Meyrick, 1899:178, pl. 4, fig. 31. **New synonym.**

Endemic. Kauai, Oahu, Maui, Hawaii (type locality?).

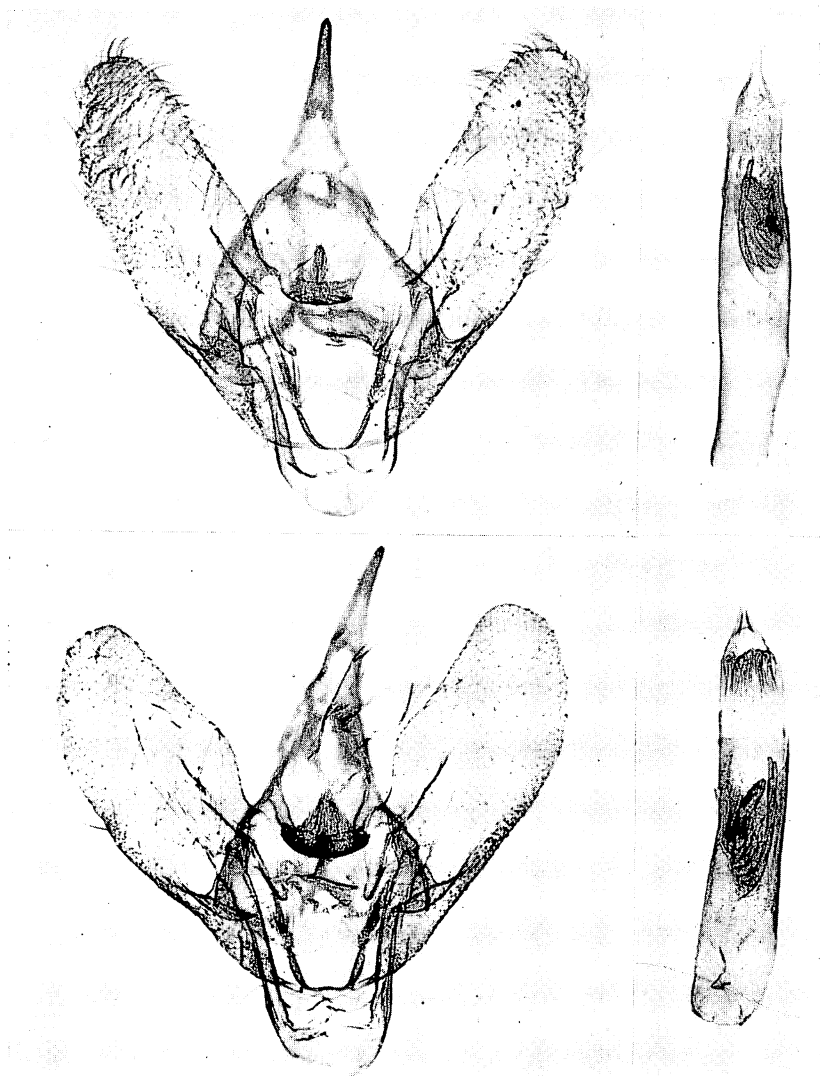


Figure 89—Male genitalia of *Scotorythra paludicola* (Butler). Above: The type; Kilauea, Hawaii. Below: The type of the synonym *idolias* Meyrick, from the same locality.

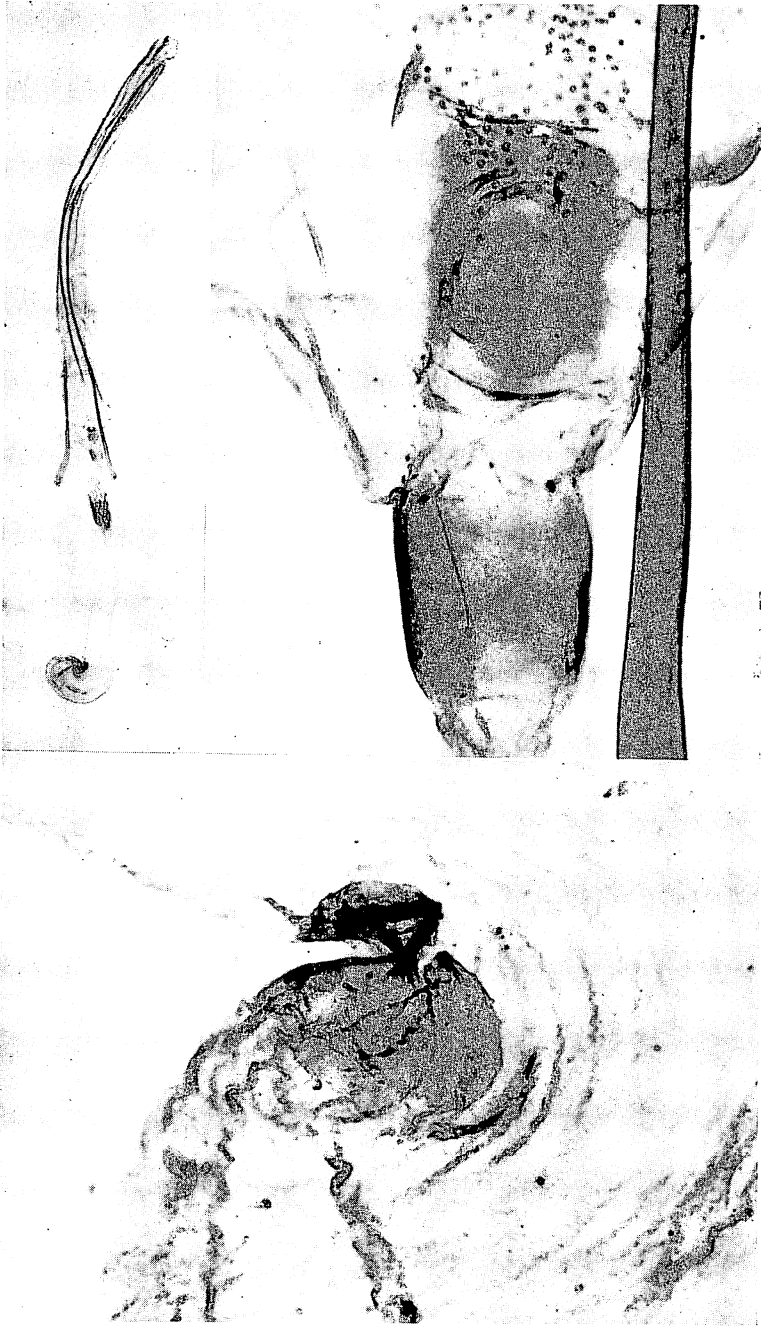


Figure 90—Female genitalia of *Scotorythra paludicola* (Butler) (from the type series ?); signum cracked.



Figure 91—Female genitalia of *Scotorythra paratactis* Meyrick; Waianae Coast, Oahu.

Hostplants: *Acacia koa* (principal host), *Grevillea*, *Tristania*.

Parasites: *Enicospilus mauicola* Ashmead, *Frontina archippiwora* Williston, *Hyposoter exiguae* (Viereck), *Pristomerus hawaiiensis* Perkins, an unidentified fungus disease.

Predator: *Oechalia similis* Usinger.

The variability in this species is great, and Meyrick's *idolias* cannot be maintained. The male holotype of *paludicola* bears the following Blackburn field data: "Sandw. Isl. 79-8 No. 58." The male holotype of *idolias* was taken at Kilauea, Hawaii, by Perkins, and it is possible that Blackburn's specimen came from the same locality.

The male type of *paludicola* appears as if it might be a diminutive *brunnea* or a small *leptias*; the hind tarsus is 4.5 mm. long and the hind tibia 5 mm. long. It appears that Meyrick's series under the name *paludicola* is a mixed one and that he did not know exactly what true *paludicola* is. On the type of *idolias*, the hind tarsus is 5 mm. long and the hind tibia 6.5 mm. long.

On occasion, this species develops enormous populations and defoliates the koa trees. Dr. Perkins (1913:151) said:

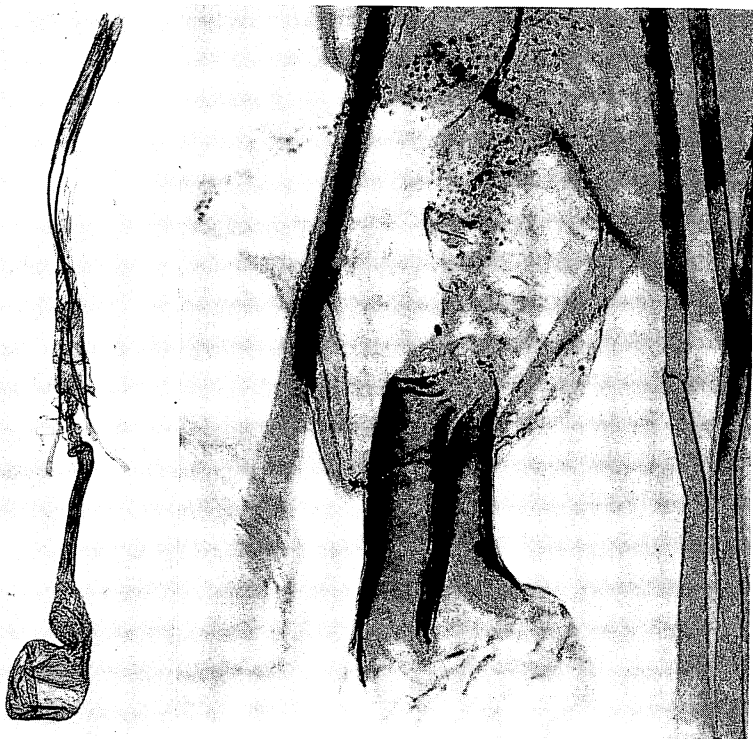


Figure 92—Female genitalia of the type of *Scolorythra platycapna* Meyrick; Waimea Mts., Kauai. No signum is evident.

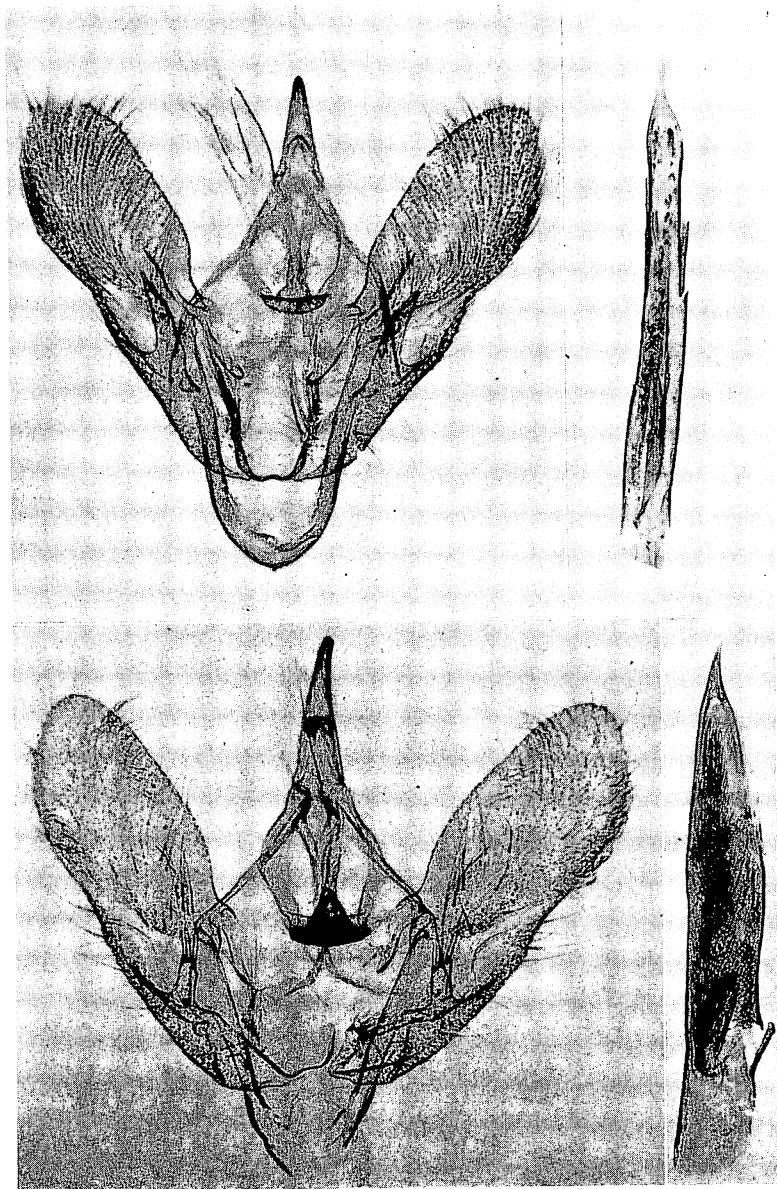


Figure 93—Above: Male genitalia of *Scotorythra paratactis* Meyrick, type; Waianae Coast, Oahu. Below: Of *rara* (Butler), type; Haleakala, Maui.



Figure 94—Female genitalia of *Scotorythra rara* (Butler), allotype; "Hawaii 80-31 (90)."



*Acacia koa* is attacked by numerous species, and certain of these become locally and periodically so numerous that great areas of "Koa" forest are entirely denuded of their phyllodes. When this denudation is long continued we have known trees to be entirely killed, not perhaps altogether directly owing to the attacks of *Scotorythra*, but because, after a sickly condition had been induced by the denudation of foliage, other insects (e.g. the longicorn beetles of the genus *Plagithmysus* and the small, boring Scolytidae) joined in the attack. *Scotorythra idolias* on Hawaii and *S. paludicola* on Maui were responsible for two of the most severe attacks that we have witnessed. Native birds attracted in thousands by the abundance of this, one of their favourite foods, were gorged to repletion, and the starving caterpillars formed writhing masses on the ground beneath the tall Koa trees. The dropping of excrement from the trees on the dead leaves beneath made a rattling noise as of a hailstorm. In one instance it was noted that these pests of caterpillars were destroyed by an epidemic fungous disease, which attacked the full-grown larvae after their descent to the ground for pupation, as well as the pupae themselves.

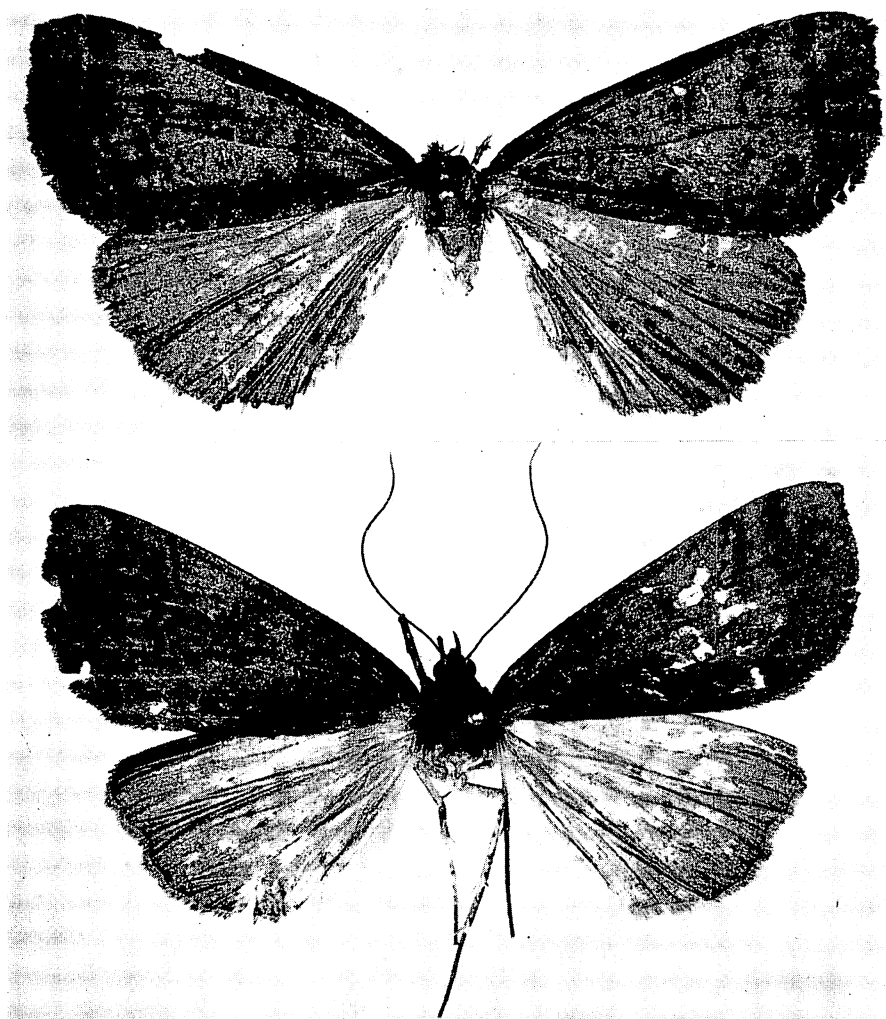


Figure 95—Above: *Scotorythra rara* (Butler), male type; "Sandw. Isl. 79-8 No. 59"; expanse, 43 mm. Below: Allotype female of *rara* (Butler); "Hawaii 80.31 (90)"; expanse, 49 mm. (Such code numbers refer to Blackburn material studied by Butler.)



Dr. Swezey (1931:493) has reported that in January, 1926, the nearly complete defoliation of the koa trees in the Olinda forest of Maui made the trees appear to be dead when viewed from the lowlands. Dr. Perkins had witnessed a similar attack in the same area about 30 years previously.

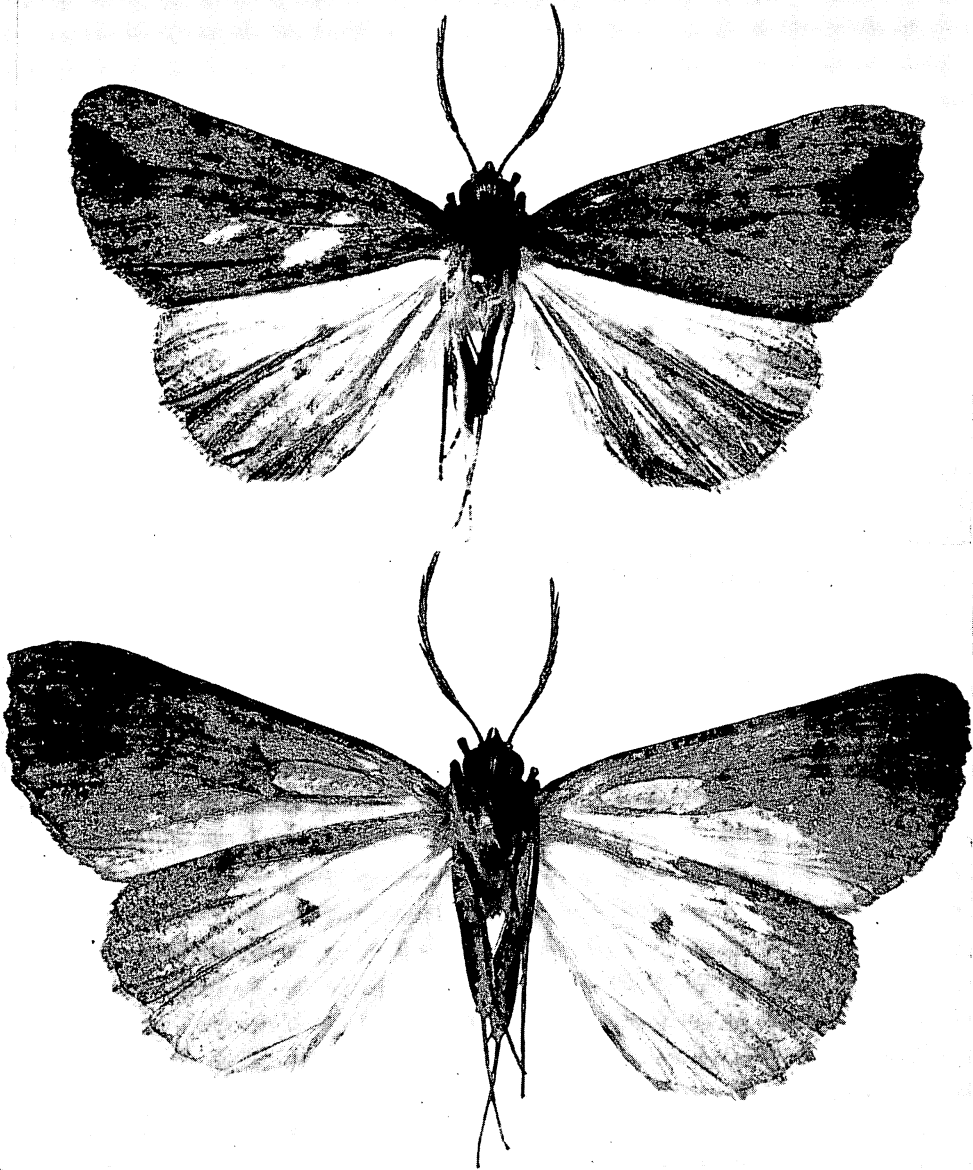


Figure 96—Dorsal and ventral views of *Scolorythra trachyopsis* Meyrick, male type; Kaholua-mano, Kauai; expanse, 43 mm. Note the patches of specialized scales on the ventral surface of the fore wing and compare figure 52 of *epixantha*.

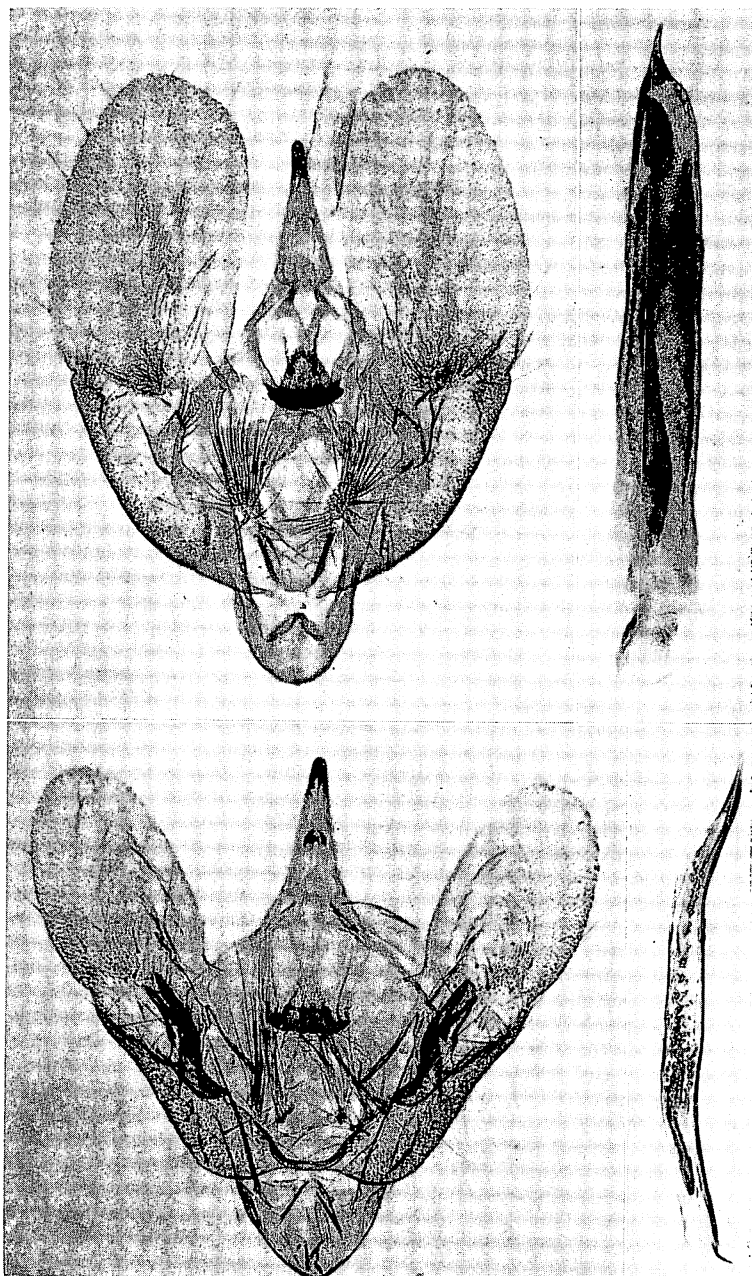


Figure 97—Above: Male genitalia of *Scotorythra trachyopsis* Meyrick, type; Kaholuamano, Kauai. Below: Of *trapezias* Meyrick, type; Waimea Mts., Kauai.

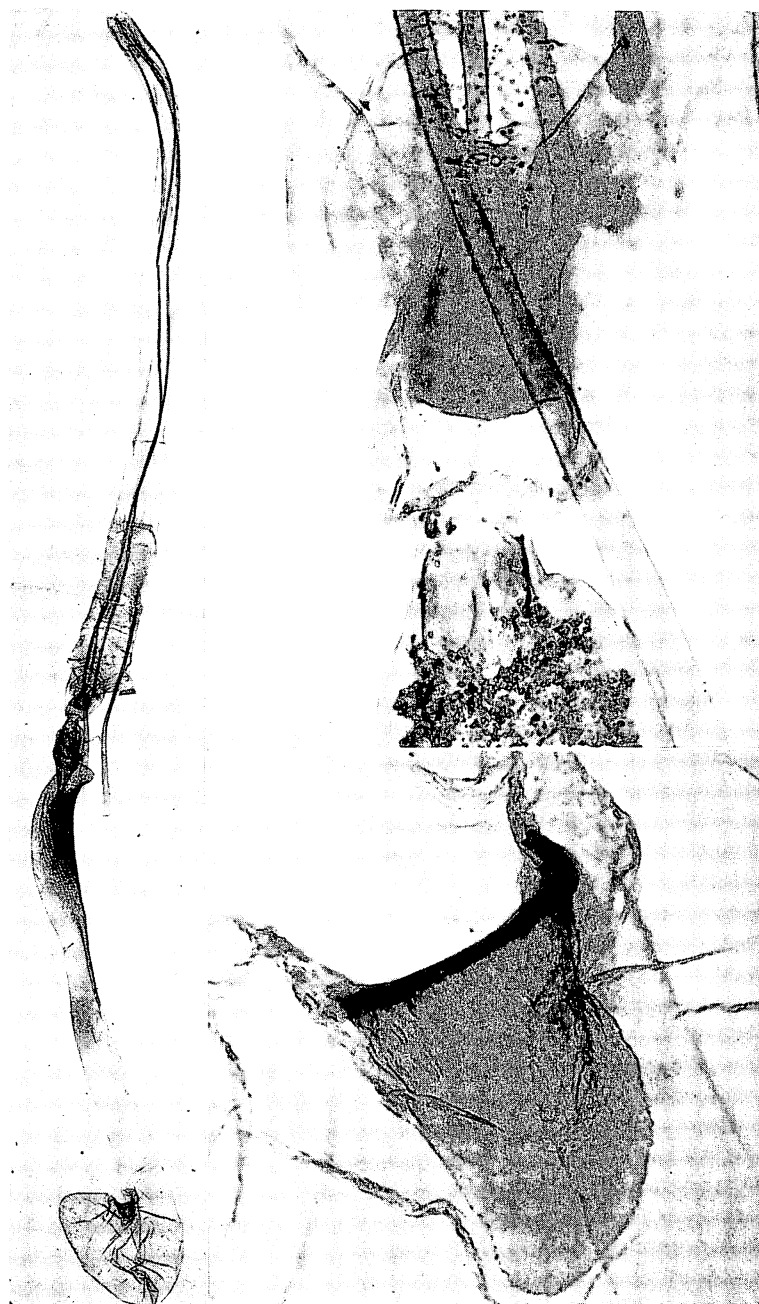


Figure 98—Female genitalia of *Scotorythra trachyopsis* Meyrick; Waimea Mts., Kauai.

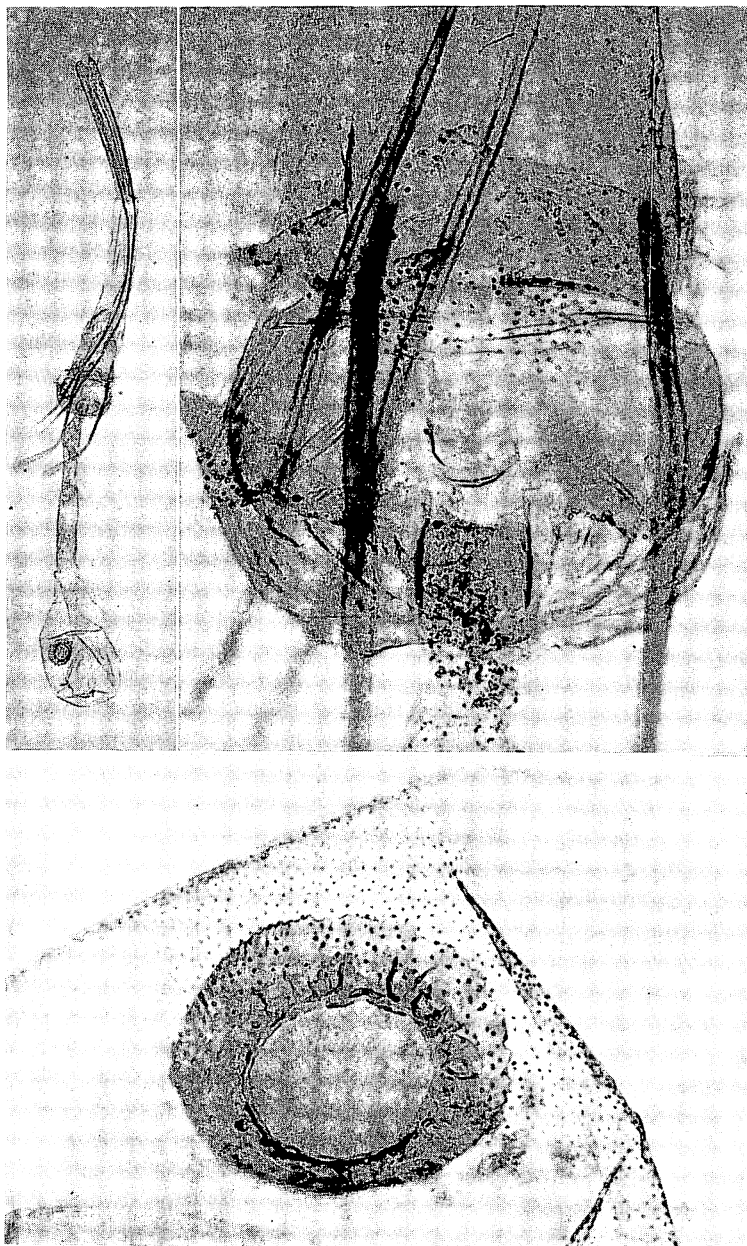


Figure 99—Female genitalia of *Scotorythra trapezias* Meyrick; Kauai.

**Scotorythra paratactis** Meyrick (figs. 88, 91, 93).

*Scotorythra paratactis* Meyrick, 1904:353.

Endemic. Oahu (type locality: Waianae coast).

Hostplant: *Dodonaea*.

Parasite: *Hyposoter exiguae* (Viereck).

**Scotorythra platycapna** Meyrick (figs. 88, 92).

*Scotorythra platycapna* Meyrick, 1899:183.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet).

Hostplant: Unknown.

**Scotorythra rara** (Butler) (figs. 93, 94, 95).

*Scotosia rara* Butler, 1879:273.

*Scotorythra rara* (Butler) Butler, 1883:177. Meyrick, 1899:187, pl. 3, figs. 5, 5a-d; 1904:354.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala), Hawaii.

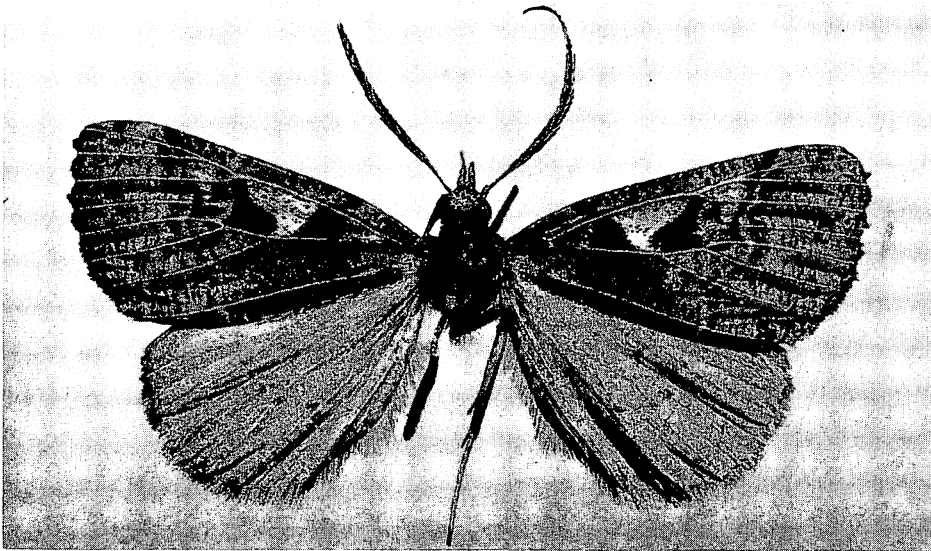


Figure 100—*Scotorythra trapezias* Meyrick, male type; Waimea Mts., Kauai; expanse, 33 mm.

Hostplants: *Acacia koa*, *Cheirodendron gaudichaudii*, *Cibotium*, *Cyrtandra*, *Elaeocarpus*, guava, *Metrosideros*, *Pelea*, *Pipturus*, *Rubus hawaiiensis*, *Sapindus*, *Straussia*, *Vaccinium*.

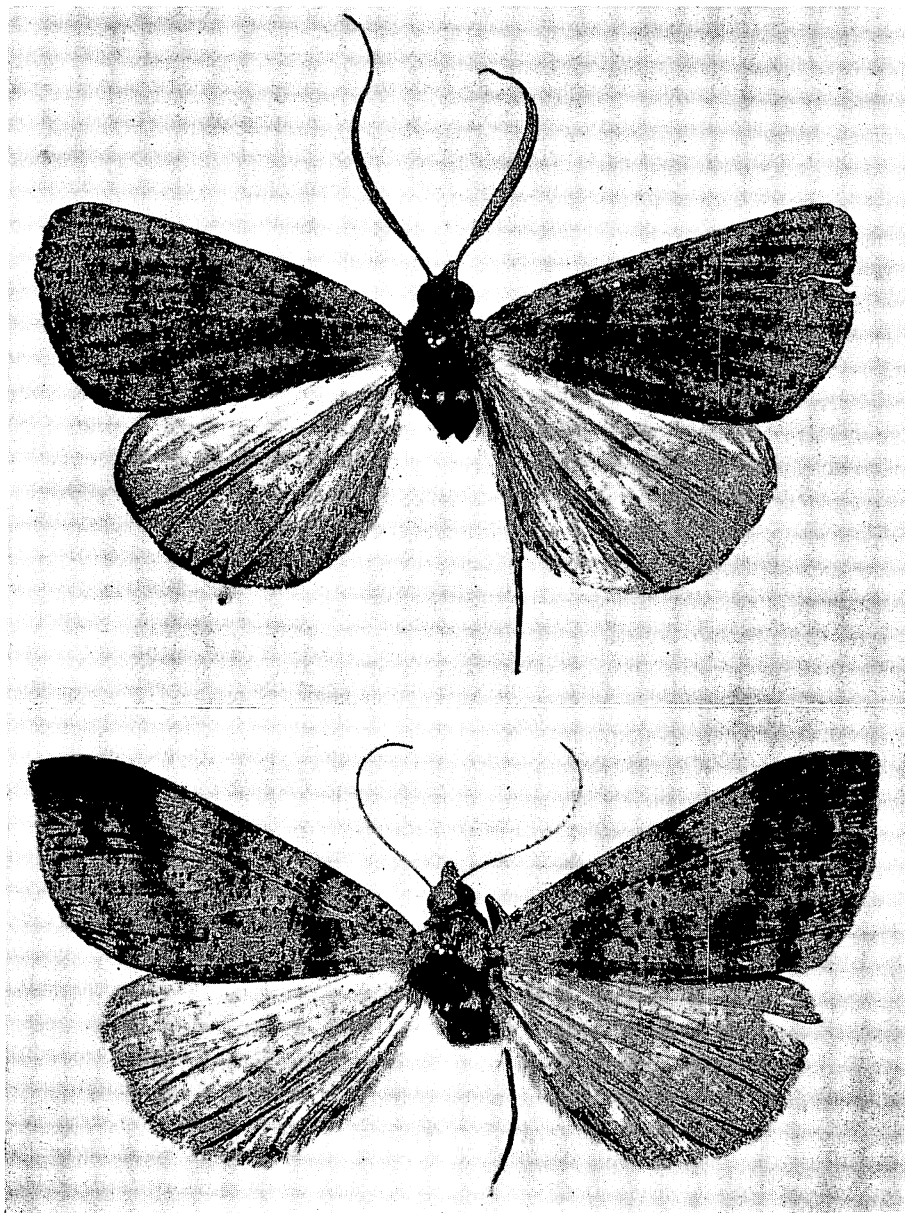


Figure 101—Above: *Scotorythra triscia* Meyrick, male type; Wailuku, Maui; expanse, 38 mm. Below: A female from Molokai, 1,000 feet; expanse, 39 mm.

Parasite: *Chaetogaedia monticola* (Bigot).

Predator: *Oechalia*.

The name *rara* is unfortunate for this species, because it is our most common, widespread and polyphagous species of the genus. It even exists in areas from which the native forest has long been exterminated. The caterpillars, which are variegated with gray, brown and green, may cause considerable defoliation of the hostplants.

***Scotorythra trachyopis*** Meyrick (figs. 96, 97, 98, 108).

*Scotorythra trachyopis* Meyrick, 1899:184.

Endemic. Kauai (type locality: Kaholuamano).

Hostplant: Unknown.

On the under side of the cell in the fore wing of the male is a dense mat of specialized, yellow-white scales. This patch is somewhat like that found in "*Nesochlide*" *epixantha*, but on *trachyopis* it is not bounded behind by broad, erect scales; the vestiture around it is elongated or hair-like. There is also a specialized area in the hind wing, but it is much less extensive and is unlike that of the fore wing. Here we have a tendency toward the development of the remarkable

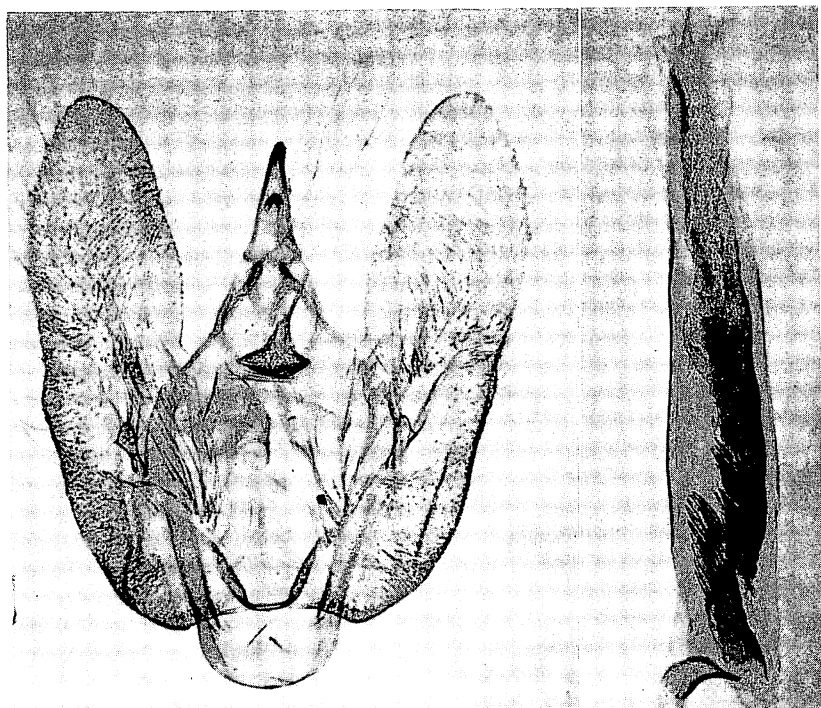


Figure 102—Male genitalia of the type of *Scotorythra triscia* Meyrick; Wailuku, Maui.





Figure 103—Female genitalia of *Scotorythra triscia* Meyrick; Molokai.



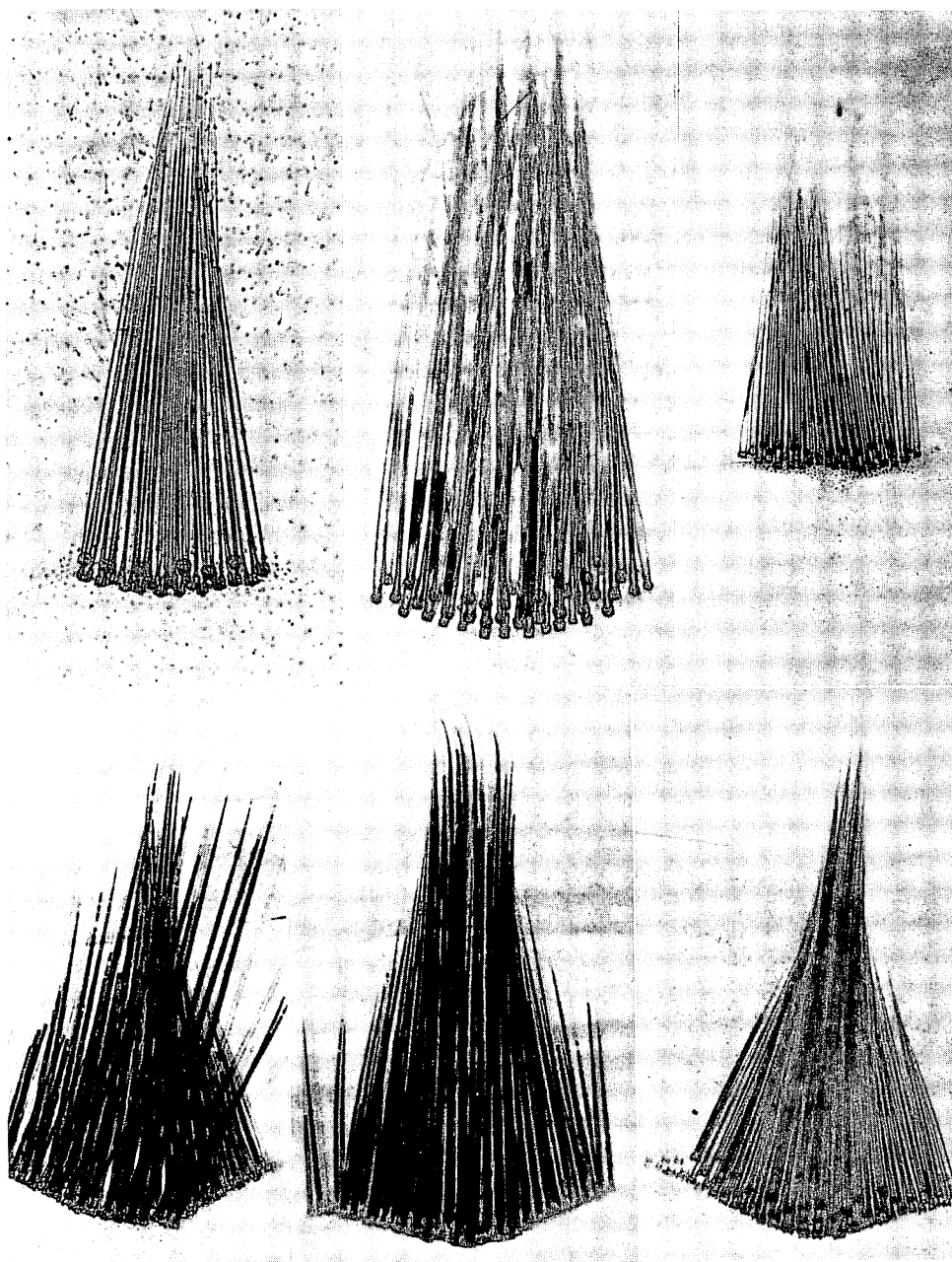


Figure 104—Clusters of spines near base of abdomen on male *Scotorythra*. Top row, left to right: Type of *arboricolans* Butler; *homotrias* Meyrick; *syngonopa* Meyrick (these three "species" are synonyms). Bottom row: Type of *brunnea* (Warren); type of *brachytarsa* Meyrick (a synonym of *brunnea*); another example of *brunnea*. Note the individual variation.

specialized vestiture which is found in its most extreme form in *gomphias* and *ochetias*. One would expect from the similar development of the cell patch that this species would be allied to *epixantha*, but the genitalia reveal that the two species are not closely allied. In fact, the genitalia separate them very widely in the genus. The wide valves make an approach only to those of *artemidora*.

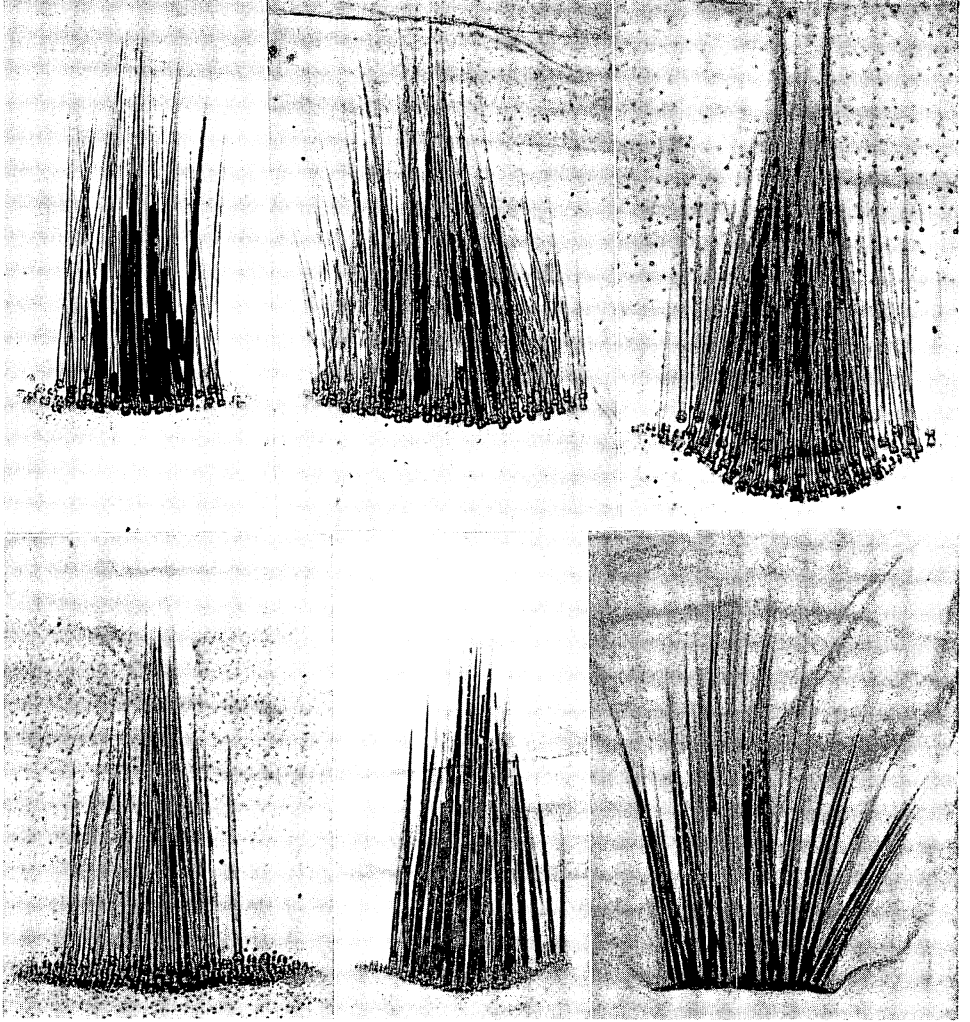


Figure 105—Clusters of spines near base of male abdomen in *Scotorythra*. Top row, left to right: *caryopsis* Meyrick (from the type of *isopora*); *corticea* (Butler) (from the type of *aruraea*); type of *demetrius* Meyrick. Bottom row: Type of *dissotis* Meyrick; *diceraunia* Meyrick; type of *epixantha* (Perkins).

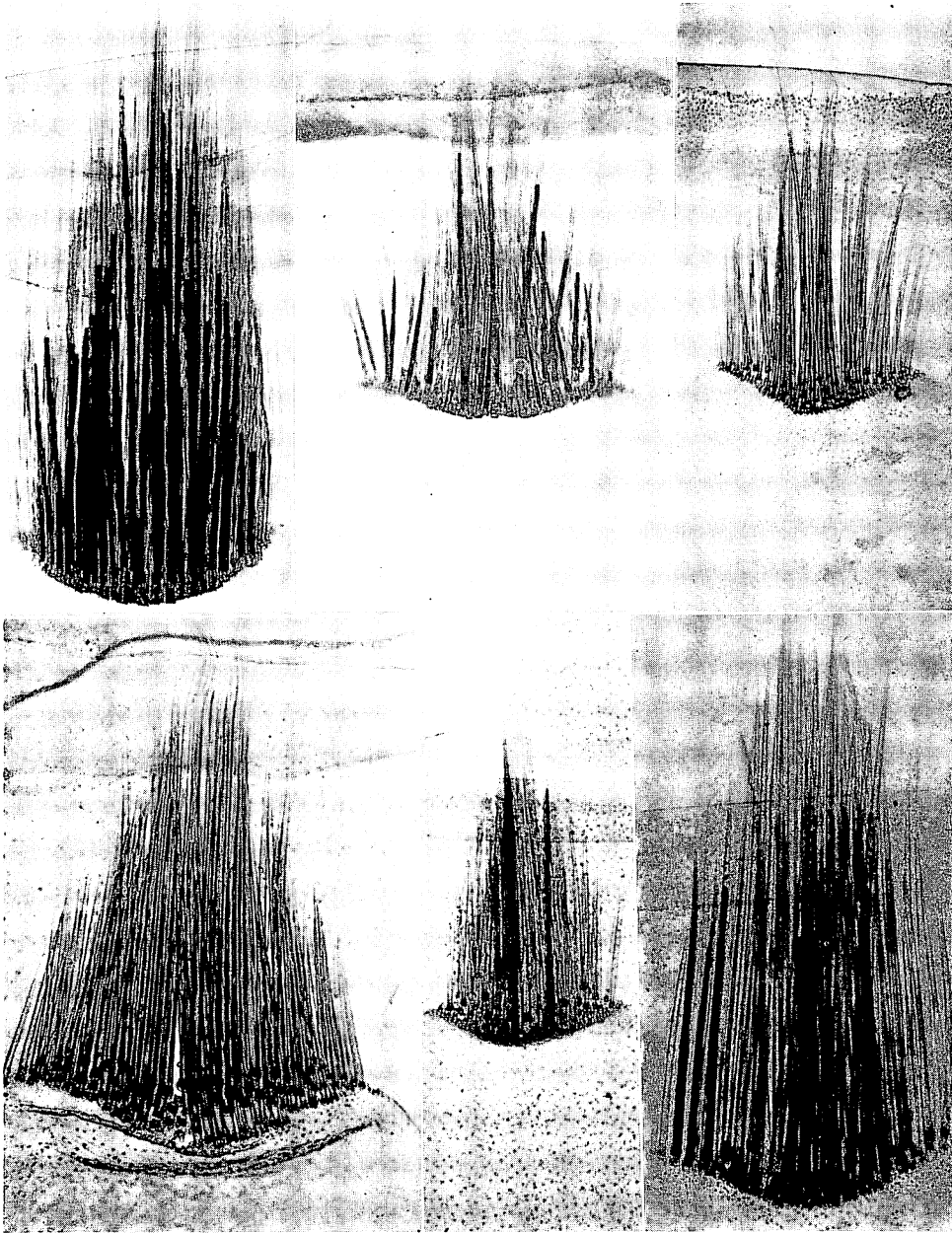


Figure 106—Clusters of spines near base of abdomen on male *Scotorythra*. Top row, left to right: Type of *gomphias* (Meyrick); *goniastis* Meyrick; another example of *goniastis*. Bottom row: *hecataea* Meyrick; *kuschei* Swezey, type; *leptias* Meyrick.

**Scotorythra trapezias** Meyrick (figs. 97, 99, 100, 108).

*Scotorythra trapezias* Meyrick, 1899:177, pl. 4, fig. 30.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet), Oahu, Molokai, Maui, Hawaii.

Hostplant: *Dodonaea*.

Parasites: *Chaetogaedia monticola* (Bigot), *Hyposoter exiguae* (Viereck).

The harpes of the valves of the male genitalia are of unique form in this species; they are split at the apex. No other species of *Scotorythra* examined has such harpes.

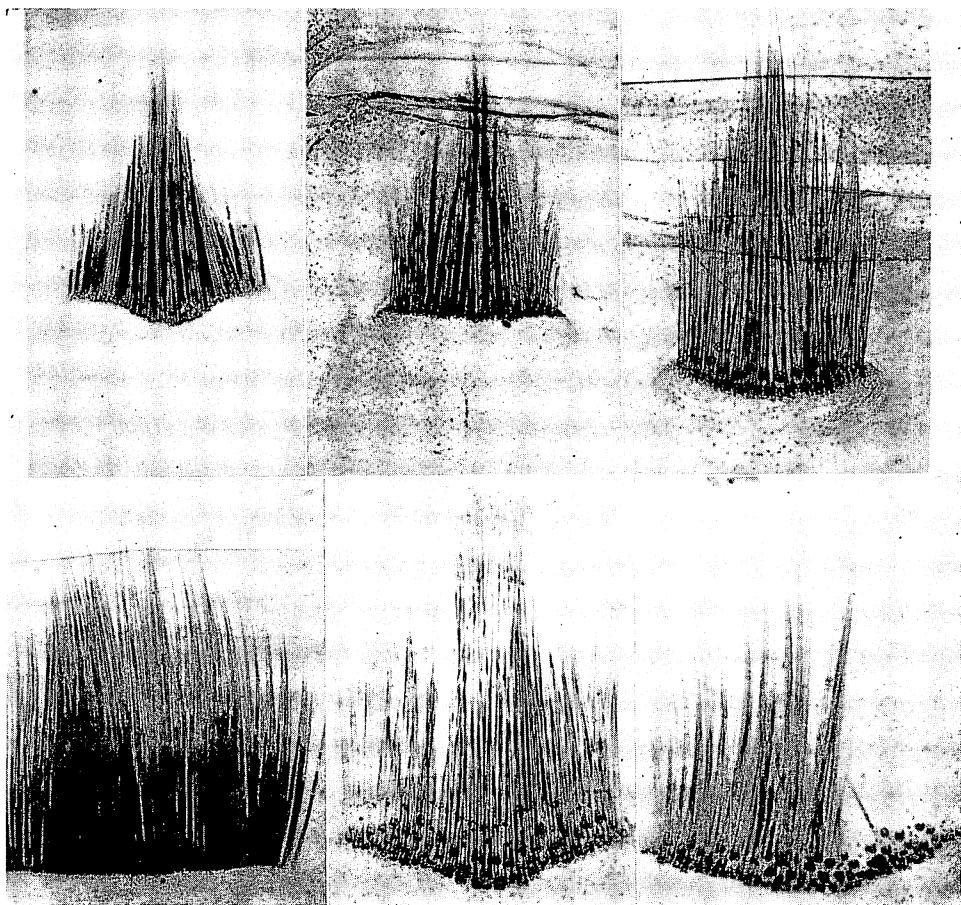


Figure 107—Clusters of spines near base of abdomen on male *Scotorythra*. Top row, left to right: *macrosoma* Meyrick, type; *nephelosticta* Meyrick, type; *nephelosticta cocytias* Meyrick. Bottom row: *ochetias* (Meyrick), type; *oxyphractis* Meyrick, type; *pachyspila* Meyrick, type.

**Scotorythra triscia** Meyrick (figs. 101, 102, 103, 108).

*Scotorythra triscia* Meyrick, 1899:182; 1900:258; 1904:132.

Endemic. Oahu, Molokai, Maui (type locality: Wailuku).

Hostplant: Unknown.

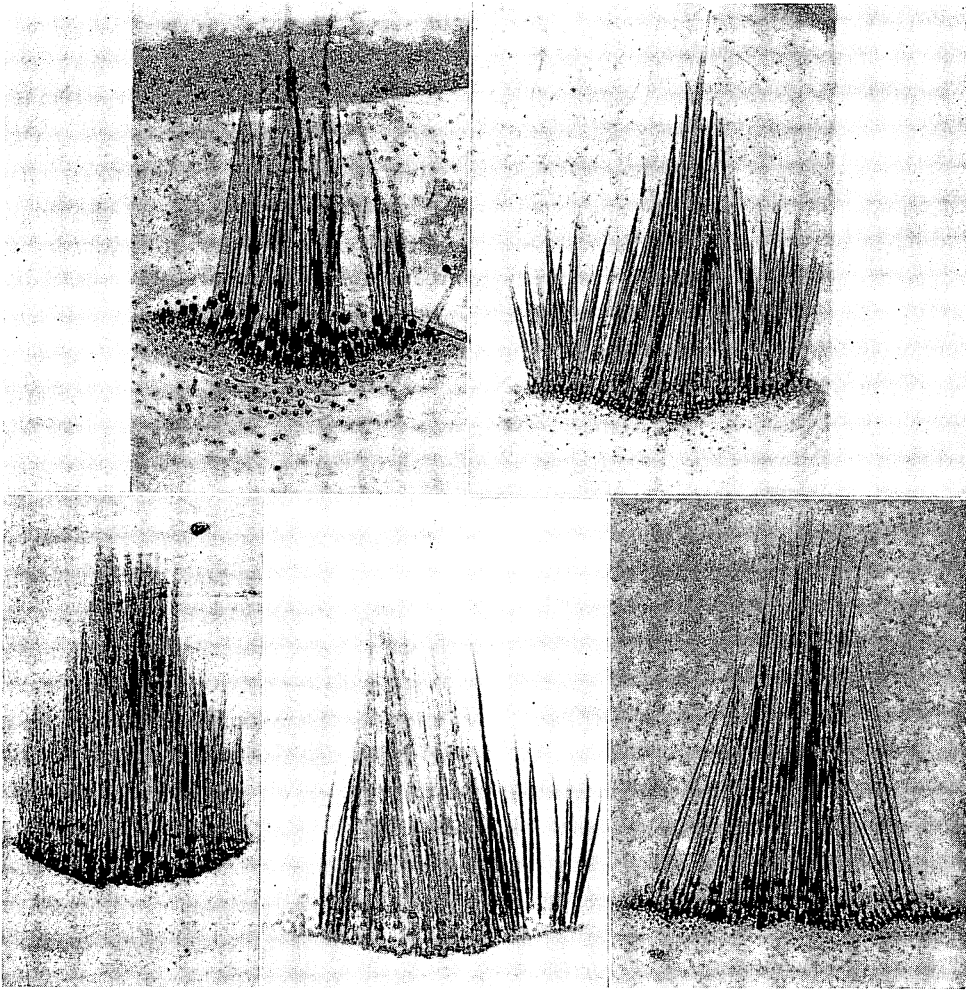


Figure 108—Clusters of spines near base of abdomen of male *Scotorythra*. Top row, left to right: *paludicola* (Butler), type; *idolias* Meyrick (a synonym of *paludicola*). Bottom row: *trachyopsis* Meyrick, type; *triscia* Meyrick, type; *trapezias* Meyrick, type.

Subgenus **ACRODREPANIS** (Perkins), **new status**

Genus *Acrodrepanis* Perkins, 1901:251. Meyrick, 1904:355, redescription.

Perkins erected *Acrodrepanis* for a single male specimen of a large and remarkable native geometer, and he characterized the genus as follows: "Antennae of ♂ formed as in *Scotorythra*, but with the pectinations unusually short, only three or four times as long as the widest part of the shaft. Whole body beneath densely hairy. Termen of fore-wings excised below the apex so as to be distinctly falcate. Hind-wings conspicuously hairy from the dorsal margin to the middle. All the leg joints to and including the basal joint of tarsi hairy; posterior tibiae very short, hardly longer than the tarsi, and without a hair pencil. Abdomen densely hairy at the side, more robust than in the allied genera." Meyrick laid the emphasis on the hairy femur, tibia and first tarsal segment to separate the group from typical *Scotorythra*. The range of variation of characters within the many members of *Scotorythra* is, however, very great, and when a careful study of the group as a whole is made, less weight can be given the features emphasized by

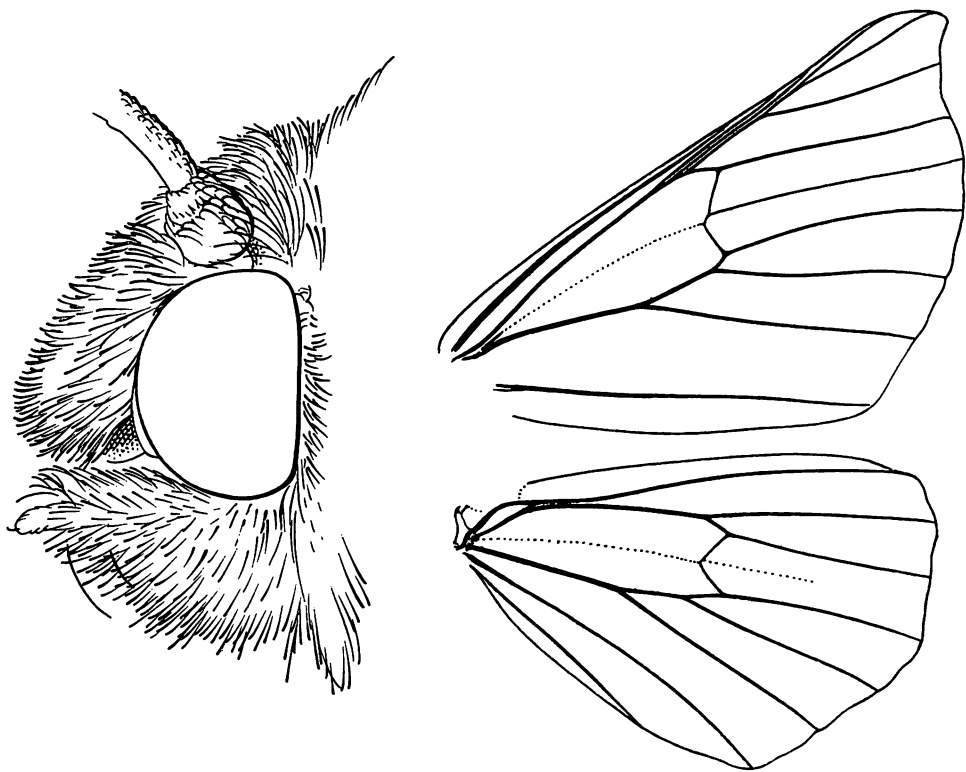


Figure 109—Head of *Scotorythra* (*Acrodrepanis*) *nesiotes* (Perkins) (left) and wing venation of *Scotorythra* (*Acrodrepanis*) *megalophylla* (Meyrick) (right).

Perkins and Meyrick. For example, the hind tibiae range in length from shorter to much longer than the hind tarsi. It appears that the two known species in this group have really not diverged sufficiently for them to be separated completely from *Scotorythra*, and I am, therefore, reducing *Acrodrepanis* to subgeneric status. Meyrick described the first of the two included species and assigned it to *Scotorythra* proper as an ally of *euryphaea* and *hyparcha*. At first sight, these large moths may appear quite distinct from many species of *Scotorythra*, but when all of the species are considered, and the genitalia studied, one must admit that there is really basically little to justify the separation of the two species from *Scotorythra*.

The characteristic cluster of spines near the base of the abdomen on most male *Scotorythra* is wanting on *Acrodrepanis*, as it is on *Tritocleis*. This may appear as an interesting divergence, but we must point out that no trace of such a cluster of spines is present on the large, and evidently allied, *Scotorythra euryphaea* and *hyparcha*. The cluster of spines in *Scotorythra* varies from very broad and strong to weak or absent.

There is a tendency for the wings of some *Scotorythra* to be slightly falcate, but in none of the species has the character become so emphasized as in *Acrodrepanis*. The variation in wing form may be traced by examining the illustrations.

The species are unexplainedly rare, and only a few specimens of these remarkable insects are known.

Meyrick (1904:355) synonymized Perkins' *nesiotes* under *megalophylla* Meyrick, but he did so in error. Only the male holotype of *nesiotes* and three female *megalophylla* were known to Meyrick, and he considered them sexes of the same species. A male of *megalophylla*, collected by Perkins, and now in the Sugar Planters' collection in Honolulu, has supplied additional evidence to demonstrate that two closely allied forms are involved. I cannot now be sure whether these forms are species or subspecies, but for the present I shall allow them specific status.

#### KEY TO ACRODREPANIS

1. Fore wings with transverse lines well developed and conspicuous, as illustrated; Oahu . . . . . **nesiotes** (Perkins).
2. Fore wings with transverse lines obsolete, as illustrated; Hawaii . . . . . **megalophylla** (Meyrick).

***Scotorythra (Acrodrepanis) megalophylla* (Meyrick), new combination**  
(figs. 109, 110, 111, 112, 113).

*Scotorythra megalophylla* Meyrick, 1899:189, female.

*Acrodrepanis megalophylla* (Meyrick) Meyrick, 1904:355.

Endemic. Hawaii (type locality: Kona, 3,000 feet).

Hostplant: Unknown.

This species has an expanse of about three inches, and thus, excluding the Sphingidae, it is the largest endemic moth in Hawaii. This species has been taken above Hilo, at Olaa, at Kilauea, and at Kona.



**Scotorythra (Acrodrepanis) nesiotes** (Perkins), new combination (figs. 109, 110, 112).

*Acrodrepanis nesiotes* Perkins, 1901:252, male. Meyrick, 1904:355. Type of *Acrodrepanis*.

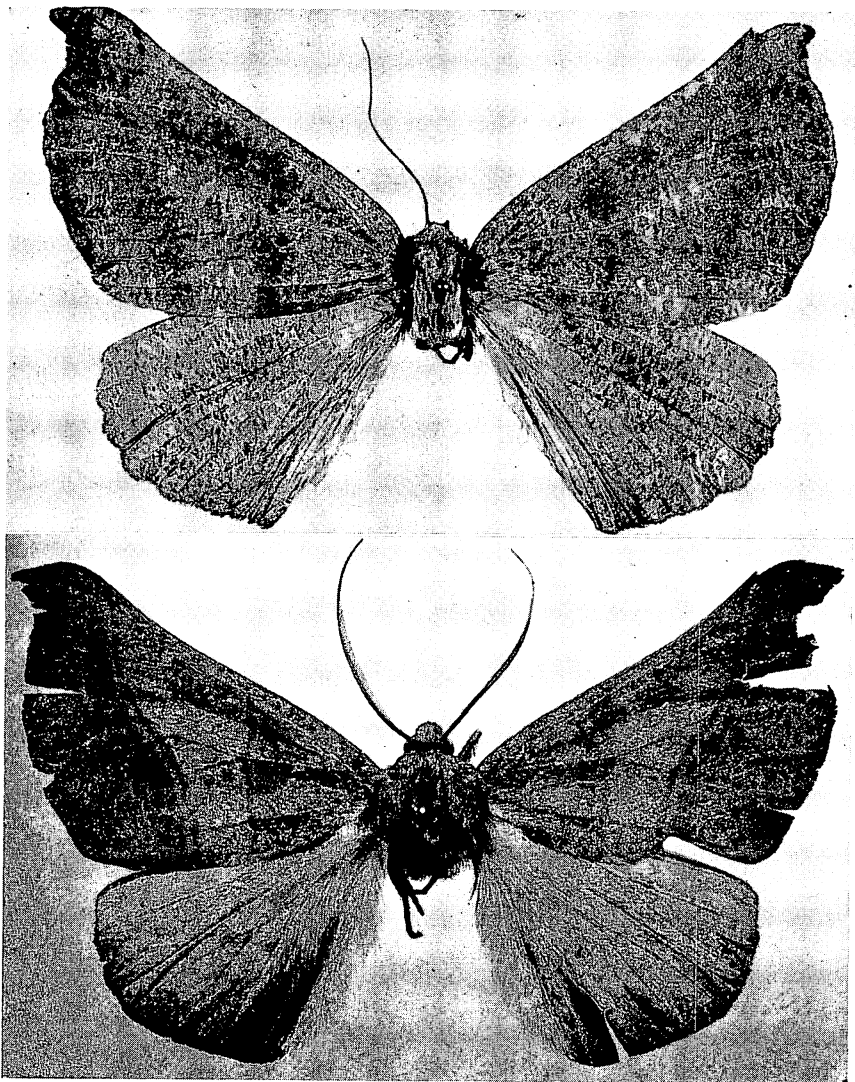


Figure 110—Above: *Scotorythra (Acrodrepanis) megalophylla* (Meyrick), female type; Kona, Hawaii, 3,000 feet; expanse, 72 mm. Below: Type male of *Scotorythra (Acrodrepanis) nesiotes* (Perkins); northwestern Koolau Mts., Oahu, 2,000 feet; expanse, 49 mm.



Endemic. Oahu (type locality: northwest Koolau Range, 2,000 feet).

Hostplant: Unknown.

Only the brightly colored holotype male is known, in spite of the extensive insect collecting on the Island of Oahu. Perkins said that the expanse of the unique type was 56 mm., but I make it only 49 mm.

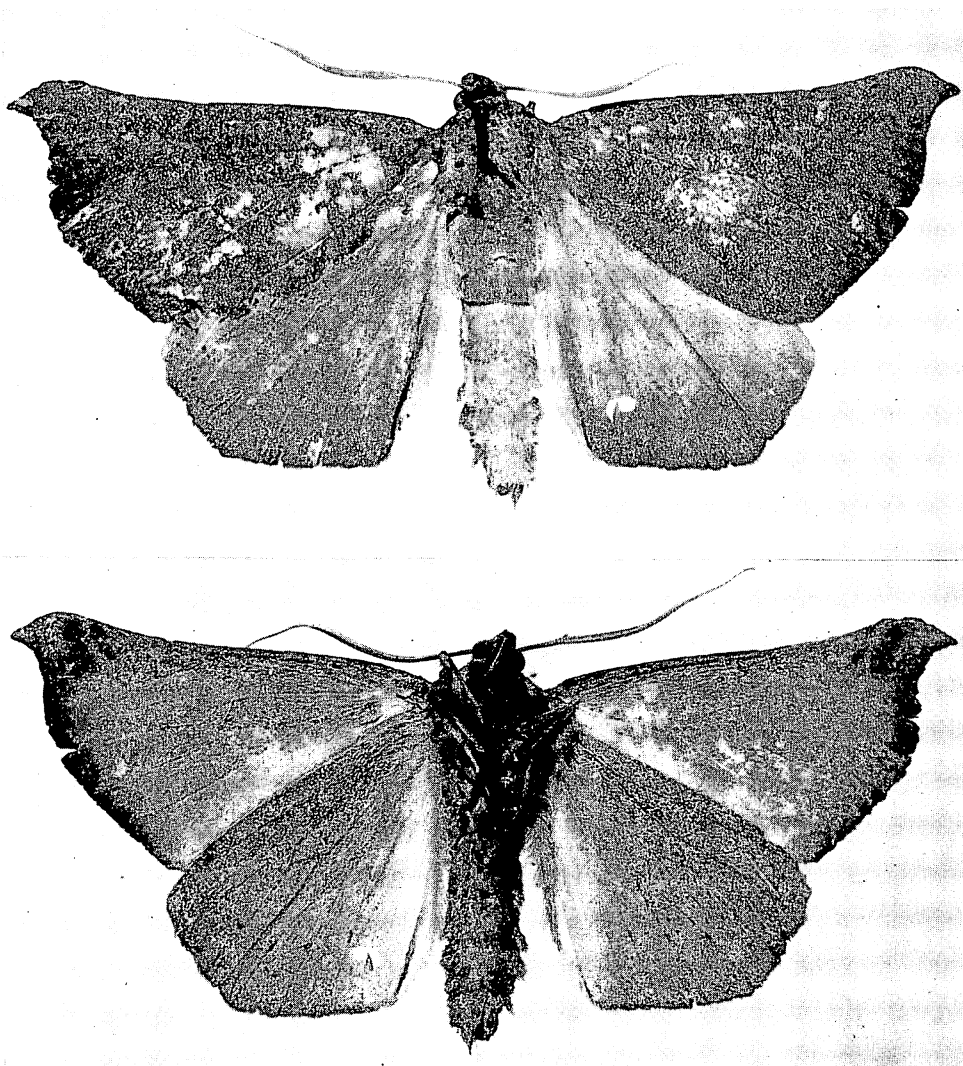


Figure 111—Dorsal and ventral views of a male *Scotorythra* (*Acrodrepanis*) *megalophylla* (Meyrick); Kilauea, Hawaii; collected by Perkins.

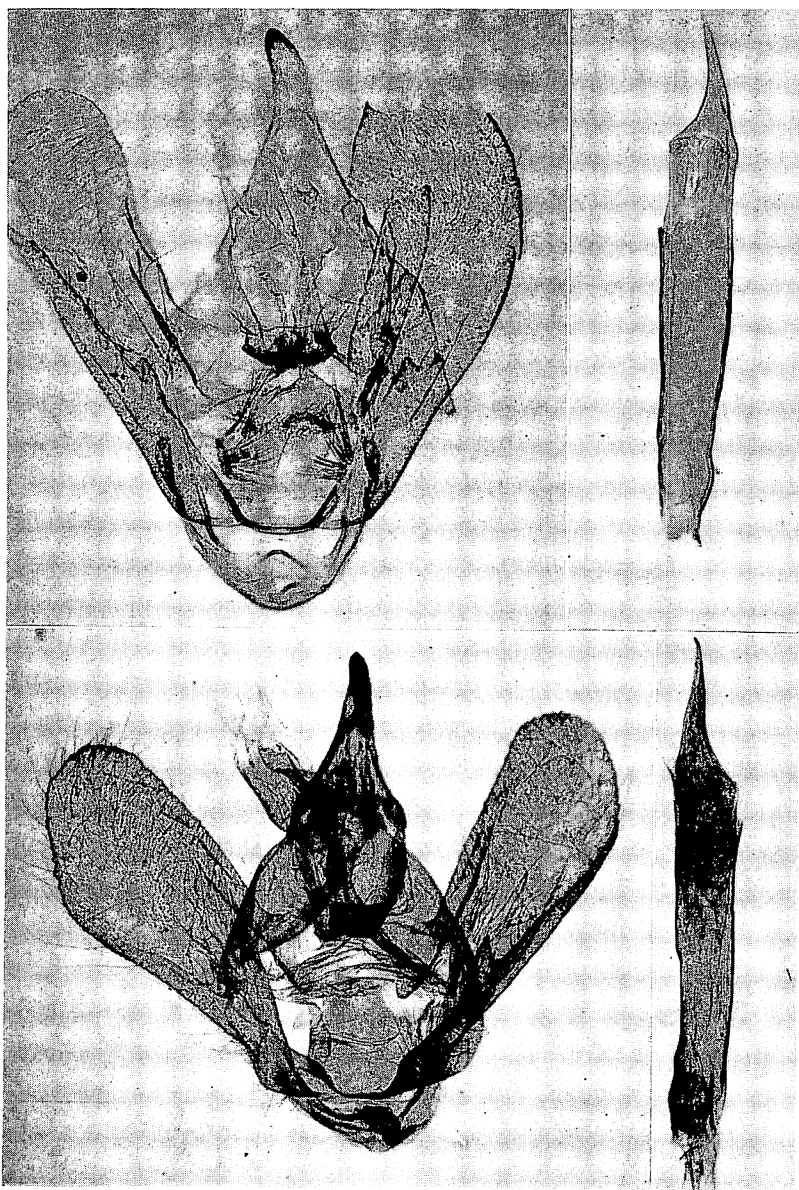


Figure 112—Above: Male genitalia of *Scotorythra* (*Acrodrepanis*) *nesiotes* Perkins, type; north-western Koolau Mts., Oahu. Below: Of *megalophylla* (Meyrick); Kilauea, Hawaii; collected by Perkins.

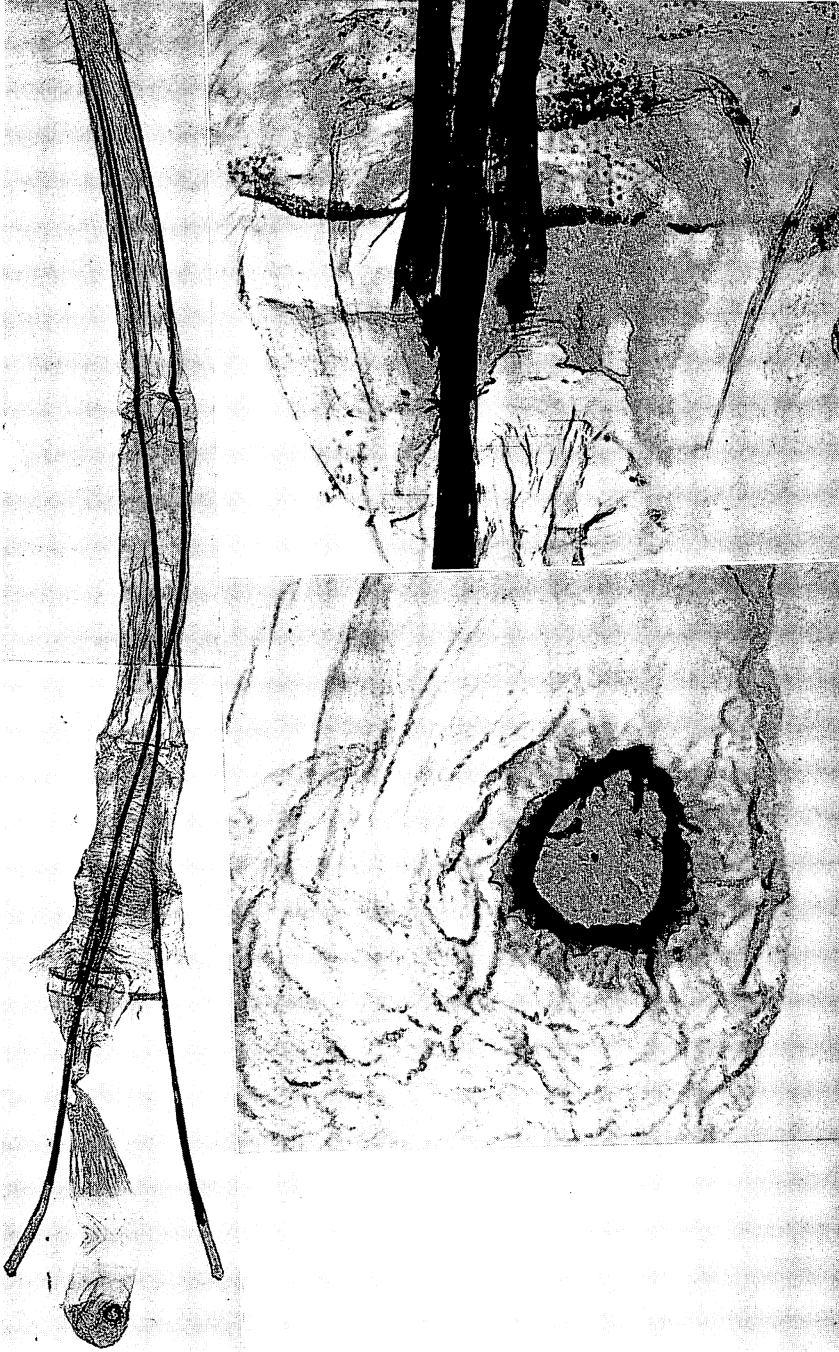


Figure 113—Female genitalia of the type of *Scotorythra* (*Acrodrepanis*) *megalophylla* (Meyrick); Kona, Hawaii.

Genus **TRITOCLEIS** Meyrick, 1899:190

This endemic genus is known only from the unique male holotype in the British Museum. It appears to be our most divergent offshoot of *Scotorythra*. The one example known differs from our other native Ennominae by having an areole in the fore wing. This venational feature is most unusual and recalls the Larentiinae. The structure of the palpi also is distinctive, and the first segment is mostly concealed between the eyes.

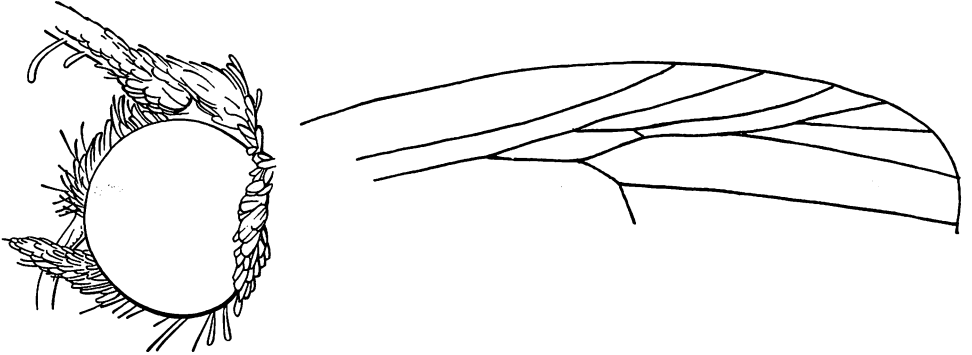


Figure 114—Head (left) and part of fore wing venation (right) of *Tritocleis microphylla* Meyrick.

***Tritocleis microphylla*** Meyrick (figs. 114, 115).

*Tritocleis microphylla* Meyrick, 1899:190, pl. 5, fig. 6.

Endemic. Hawaii (type locality: Olaa).

Hostplant: Unknown.

This species, with its wing expanse of only 20 mm., is the smallest of our Ennominae, and it seems out of place with its large relatives. In this subfamily, it is easy to distinguish because of its small size and its rather creamy-white color which is "peppered" with dark specks. The dark discal spot is much better developed on the upper side of the hind wing than on the fore wing. Also, it is strongly marked on the under side of the hind wing, but poorly developed on the under side of the fore wing.

The antennae are said by Meyrick to have the apical third simple. Only a small basal section of the left antenna remains on the type, and the distal part of the right antenna is missing. The simple terminal parts of the antennae must have been broken off before the artist drew the specimen for *Fauna Hawaiiensis*, because the drawing does not show this. Meyrick's use of "glabrous" in describing the femora is incorrect, because they are densely squamose. Each branch of the antennal pectinations is finely setose beneath, and just before the apex there arises

a very long seta set at nearly right angles to the branch. The antennal shaft, viewed from above, has the distance between the branches near the twelfth segment as long as the greatest thickness of the shaft at the origins of the branches.

The male has no trace of the patch of spines near the base of the abdomen which is so characteristic of most *Scotorythra*.

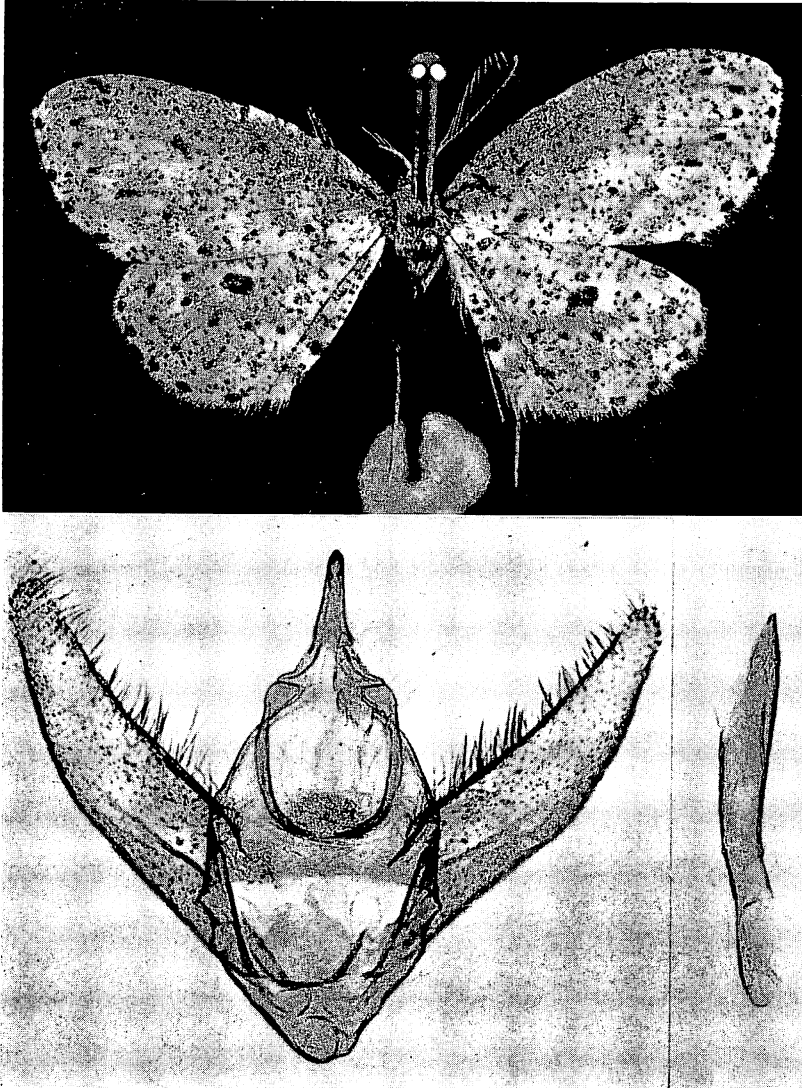


Figure 115—*Trilocleis microphylla* Meyrick, type male; Olaa, Hawaii; expanse, 20 mm.; and the genitalia.

## Subfamily LARENTIINAE (Guenée)

*Larentidae* Guenée, 1857:257.

*Hydriomenidae* Meyrick, 1891:792; 1892:57.

*Hydriomeninae*, of authors.

*Psychophorinae* Hampson, 1918:384.

It has been necessary to make extensive changes in Meyrick's classification of the Hawaiian members of this subfamily. Inadequate material has rendered impossible the drafting of a key which satisfies my wishes, and it is to be hoped that this key may be greatly strengthened in future.

The Hawaiian Larentiinae may be divided into two major divisions: The first of these is represented by the widespread genus *Eupithecia*, and it bears no relationship to the other genera. The probability is greater that the ancestral *Eupithecia* has come from a Boreal rather than a tropical Pacific stock; we cannot at this time ascertain the source, but this may be possible in future. The other genera, *Fletcherana*, *Progonostola* and *Megalotica*, may have all descended from a common stock, and they have diverged widely in the Islands and are all endemics, although it is possible that *Fletcherana* represents one stock and *Progonostola* and *Megalotica* another. At this writing I have no information as to the relatives or possible source of the ancestral stock of these last three genera, although it is not unlikely that they are related to Boreal *Xanthorhoe*.

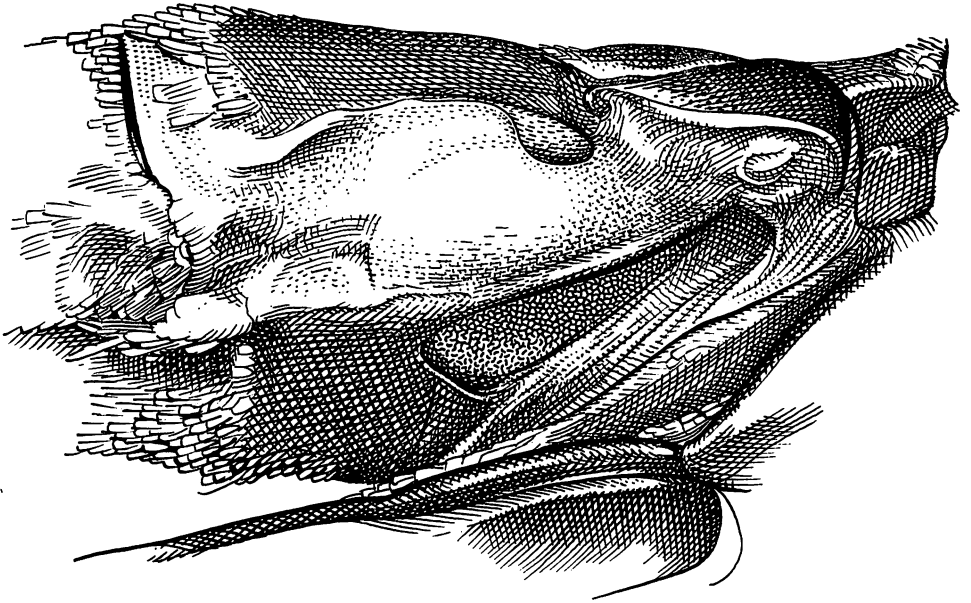


Figure 116—Lateral view of right side of the base of the abdomen, denuded, of *Eupithecia monticolans* Butler, to show oblique tympanum, posterior coxa, and associated areas. Compare figure 158.

## KEY TO THE GENERA OF THE SUBFAMILY LARENTIINAE FOUND IN HAWAII

1. Coxa and tympanum strongly oblique, and/or apex of hind coxa extends far behind posterior edge of tympanum; upper surface of wings with slightly slanting erect, or strongly erect scales in patches or lines along some veins (if not evident on fore wings, view with light directed against wings from different angles and check especially veins six, seven and eight in hind wings, which always have lines of narrower, slightly elevated scales which are different from the surrounding scales, and are usually more roundly-pointed at the apices than are those on the wing membrane; if wings are abraded, most of these elevated scales may be removed or made difficult to see without careful examination); scales on front of head all closely and flatly appressed in at least basal two-thirds; expanse usually less than 24 mm. [only in *staurophragma* (21–26 mm.) and *monticolans* (19–29 mm.) does the expanse exceed 24 mm. in known examples]; genitalia of distinctive type in our fauna, as illustrated. . . . . **Eupithecia.**

Tympanum and coxa not so strongly oblique, the coxal apex only slightly if at all extending caudad of pos-

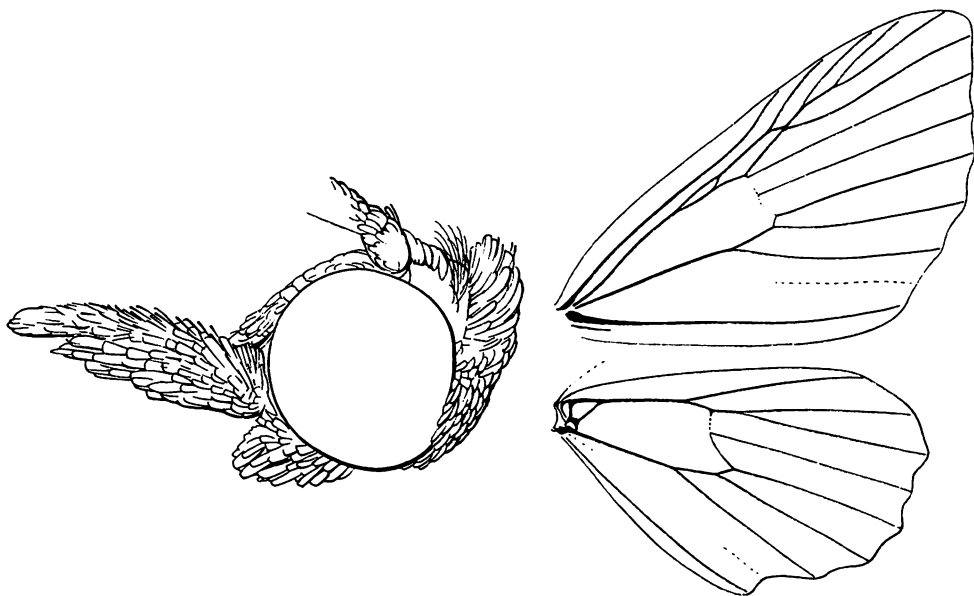


Figure 117—Head (left) and wing venation (right) of *Eupithecia monticolans* Butler.

- terior edge of tympanum; wings never with such raised or differentiated scales; expanse rarely as small as 20 mm., usually more than 30 mm.; scales on head either peaked or appressed; genitalia as illustrated for *Fletcherana*, *Progonostola* and *Megalotica*.....2
- 2(1). Dark bronzy-brown species with markings poorly developed on dorsum, and with markings obsolete or at most faintly indicated on under side.....3
- Conspicuously maculate species with markings well developed on upper and lower surfaces of both pairs of wings.....4
- 3(2). Tegulae bristling with very long, erect, shaggy hair from base to apex, as in figure 157; front of head bristling with hair, not squamose except near margins; palpi conspicuously shaggy-haired, not squamose except slightly at sides; gena partly (continuously) squamose; fore wing with vein eight leaving nine beyond middle of distance from areole to apex; uncus absent.....
- .....**Megalotica (Megalotica).**
- Tegulae, frons and palpi mostly squamose, without shaggy, erect hair (the tegulae may have some long hairs, but they are horizontal, not erect); gena entirely bare; fore wing with vein eight leaving nine before middle of distance from areole to apex; uncus present.....
- .....**Megalotica (Gela).**
- 4(2). Antennae not conspicuously pectinate in either sex; uncus present; valves finely hairy; scales on frons erected into a peak, except in the aberrant *ioxantha* where they are appressed.....**Fletcherana.**
- Antennae of male with long, heavy pectinations; uncus present or absent; valves with dense apical mass of heavy setae; scales on frons erected into a peak or appressed.....5
- 5(4). Antennae of male unipectinate; the longer setae differentiated from the ventral pilosity of the antennal segments of female very short, much shorter than the thickness of shaft, and projecting only a short distance beyond the pilosity in the vicinity of segments 10 to 15; scales on frons mostly prostrate and directed forward toward base of proboscis, the apical ones overhanging base of proboscis, and not whorled into a peak; uncus absent; juxta with lobe-like processes; pattern on hind wing of only species known continued across entire wing.....**Progonostola (Progonostola).**



Antennae of male strongly bipectinate; female with the longer setae on under side of antennal segments long and conspicuous, about as long as breadth of shaft in vicinity of segments 10 to 15; scales on anterior part of frons whorled upward into a peak and not overhanging base of proboscis; uncus present; juxta without processes; pattern on hind wing of only known species distinct only on posterior (inner) half and not continued strongly across entire wing to costal area....  
 ..... **Progonostola (Ziela).**

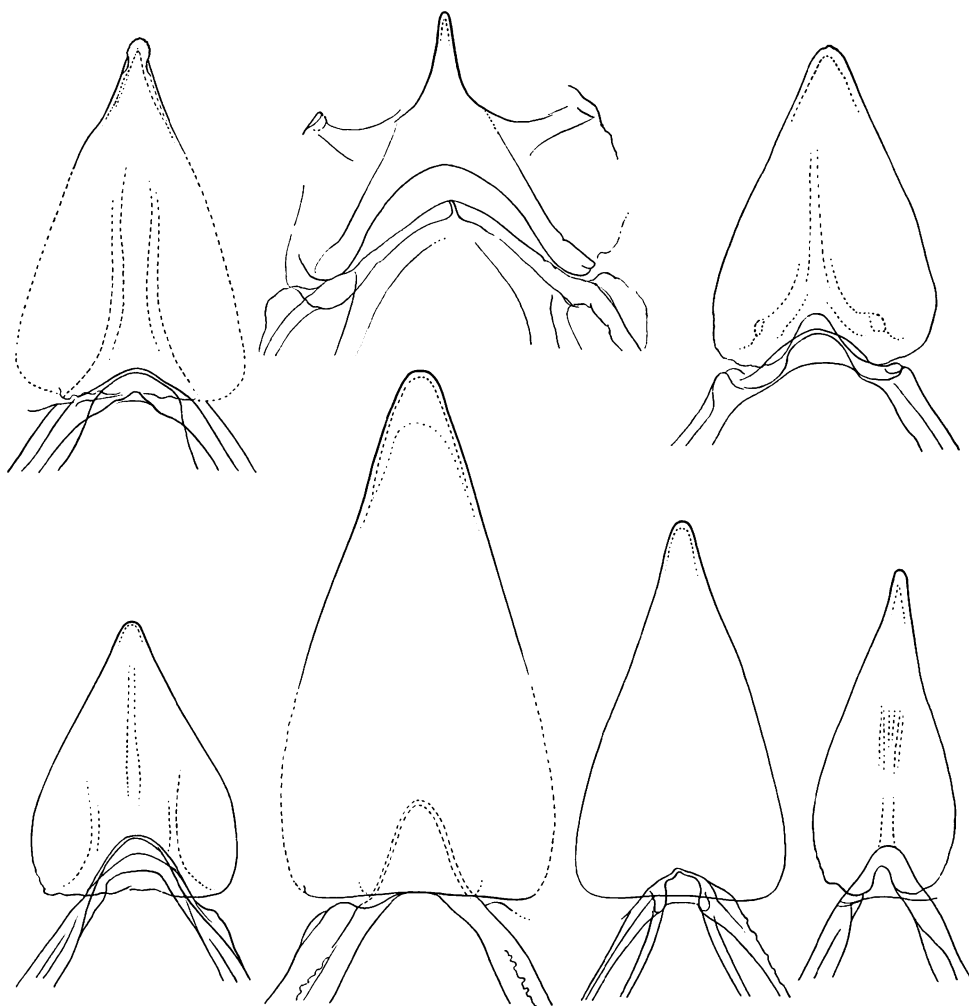


Figure 118—*Eupithecia unci*, drawn from the types. Top row, left to right: *niphoreas* (Meyrick), *monticolans* Butler, *staurophragma* (Meyrick). Bottom row: *scoriodes* (Meyrick), *orichloris* (Meyrick), *craterias* (Meyrick), *dryinombra* (Meyrick).

Genus **EUPITHECIA** Curtis, 1825

## The Pugs

Meyrick used *Eucymatoge* for this genus in *Fauna Hawaiiensis*, and that is the generic term employed in all of our Hawaiian literature since 1899. The genus *Eupithecia* is a large one with representatives in most parts of the world, and it is particularly well developed in the Holarctic. There are many species in America.

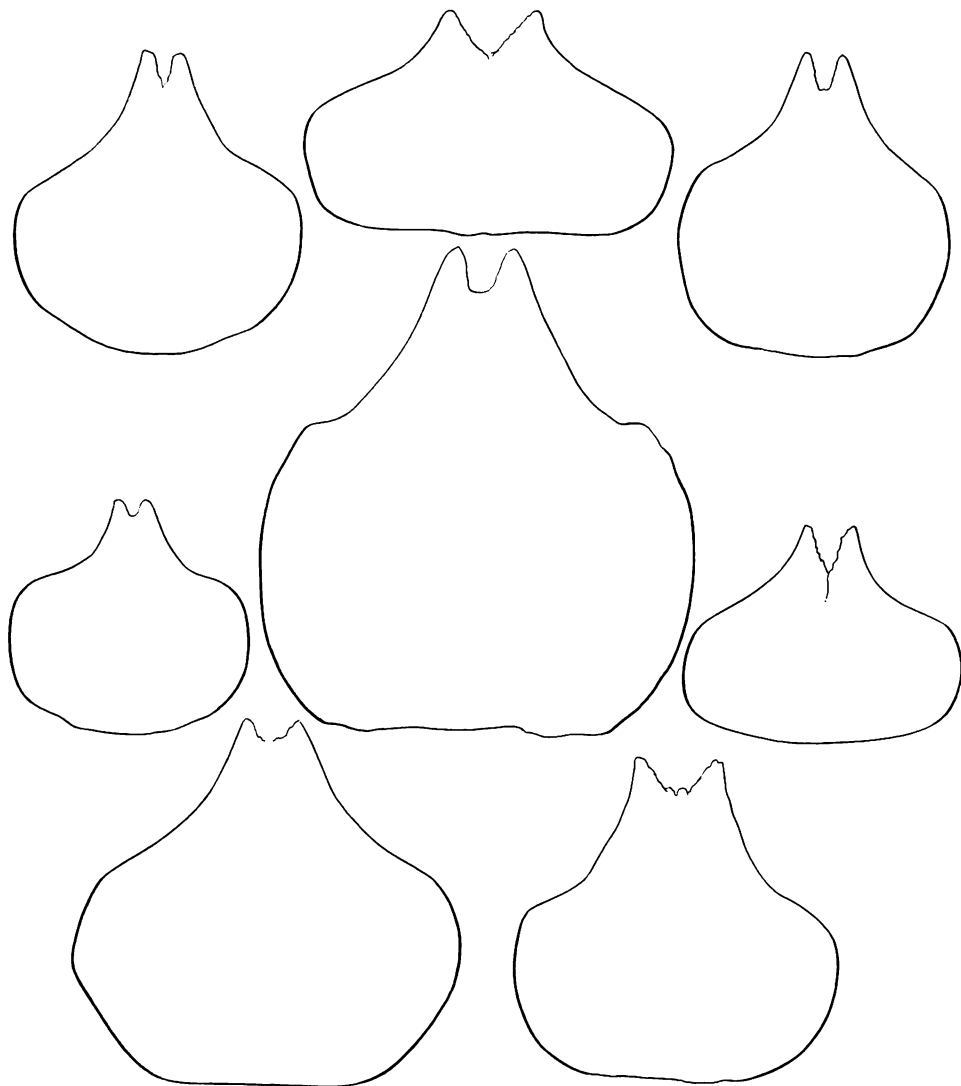


Figure 119—The form of the juxta in various species of *Eupithecia*; drawn from the types. Top row, left to right: *craterias* (Meyrick), *monticolans* Butler, *dryinombra* (Meyrick). Center row: *craterias ditrecta* (Meyrick), *orichloris* (Meyrick), *scoriodes* (Meyrick). Bottom row: *staurophragma* (Meyrick), *niphoreas* (Meyrick).

Attention has not been called to the specialized, erect or slanting scales on the upper sides of the wings which reach their peak of development on *orichloris*. No mention of these scales was made by Meyrick in his descriptions.

The sclerotized, rod-like areas on the venter of the eighth abdominal segment in the male which are so well developed on the species of some regions and offer good specific characters (see McDunnough, 1949), are obsolescent in most of the Hawaiian species, but they are, however, well developed on *monticolans*.

The scales are very flatly and closely appressed to the front of the head, except where they protrude apically.

The genitalia of the Hawaiian species do not display outstanding specific characters, and they are difficult to evaluate. Much more work is required to elucidate the Hawaiian complex of species; they are poorly known.

#### KEY TO THE HAWAIIAN EUPITHECIA

1. Hind wing with termen almost straightly cut off and forming a conspicuous angle with costa, margin dentate. . . . . **staurophragma** (Meyrick).  
Termen of hind wing convex, even though irregularly convex, dentate or not. . . . . 2
- 2(1). Fore wing with termen shallowly, but obviously concave, thus making fore wing slightly falcate. . . . . 3  
Fore wing not subfalcate. . . . . 4
- 3(2). Ground color of wings greenish or yellowish; head and palpi yellowish; wings marked as figured and with remarkable patches of large, erect scales along lower margin of cell in fore wing. . . . . **orichloris** (Meyrick).  
Ground color of wings reddish; head and palpi red; wings with distal margin of medial band characteristically angulate as figured; without such patches of erect scales on lower margin of cell. . . . . **rhodopyra** (Meyrick).
- 4(2). "Whole insect white, profusely sprinkled with black scales, giving it a nearly uniform gray appearance, with some black markings on the wings produced by the segregation of the black scales"; wings without the usual strong pattern of bands and lines. . . . .  
. . . . . **stypheiae** (Swezey).  
Not so. . . . . 5
- 5(4). Face and palpi with black and red scales intermixed, crown of head and thorax white, dark costal patches on fore wing mixed with red or orange scales and a broad band across costal half of apex of fore wings with much red or orange scaling; ground color white. . . . . **niphoreas** (Meyrick).  
Not so, without such red scaling. . . . . 6

- 6(5). Abdomen with a subbasal band containing red or reddish scales.....7  
 Abdomen without such a band, although a brown or dark band may be present.....8
- 7(6). Discal spot on fore wing conspicuous; wings rather broad, fore wing about 5 mm. wide in type.....  
 .....**craterias** (Meyrick).  
 Discal spot in fore wing obsolete; wings narrow, fore wing hardly 3.5 mm. wide in type.....  
 .....**dryinombra** (Meyrick).
- 8(6). Head mostly pale-scaled; wings with much pale or white scaling, or ground color of wings pale or white.....9  
 Head mostly dark-scaled; small (17 mm. or less), narrow-winged, predominantly very dark species.....10
- 9(8). Second plus third segments of palpi only about as long as diameter of an eye; gena wide and conspicuous below genal process (that dorsal part of gena laterad of palpifer).....**prasinombra** (Meyrick).  
 Second plus third palpal segments about one-fourth or more longer than diameter of eye; gena very narrow below genal process.....**monticolans** Butler.
- 10(8). The following two species are difficult to distinguish from the material at hand; on each of them the genae are broad:  
 Postmedial line of both wings followed by a vague white line; subterminal line vaguely white, the whole pattern sharply marked, there being numerous transverse lines on both pairs of wings.....**scoriodes** (Meyrick).  
 Postmedial line of fore wings indistinctly marked with yellowish, with no white scaling, subterminal line obsolete, pattern poorly defined and with transverse lines on wings few and obscure.....**phaeocausta** (Meyrick).

**Eupithecia craterias craterias** (Meyrick) (figs. 118, 119, 120, 122, 123).

*Eucymatoge craterias* (Meyrick), 1899:163.

*Eupithecia cratenas* (misspelling) Prout 1939 (?), pl. 38.

Endemic. Oahu, Molokai, Maui (type locality: Haleakala, 5,000 feet).

This is much like some of the forms of *monticolans*, but it is smaller in average size. On the fore wing there is a pale longitudinal zone extending from the outer side of the medial band to termen just behind the costa and a similar pale zone just behind the middle. These pale zones are variable in intensity, and in some examples they are obsolete, in others they are well defined, and in the Hawaii form called *ditrecta* (see below) they are conspicuously whitish. The second plus

third palpal segments on the male holotype are slightly longer than an eye, and the antenna is squamose above (shaft several scales wide) and furry only beneath.

***Eupithecia craterias ditrecta*** (Meyrick), **new combination** (figs. 119, 121, 122).

*Eucymatoge craterias* "geographical variety" *ditrecta* Meyrick, 1899:164.

Endemic. Hawaii (type locality: Kona).

Hostplant: Unknown.

This is a smaller race than *craterias craterias*, and the longitudinal white zones on the fore wing are more pronounced.

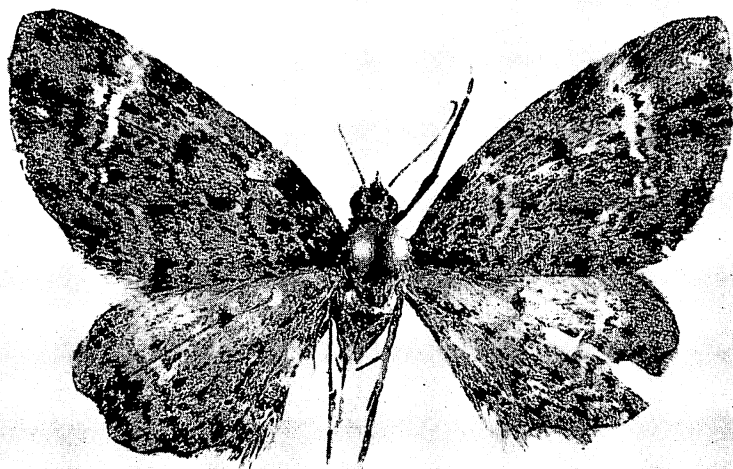
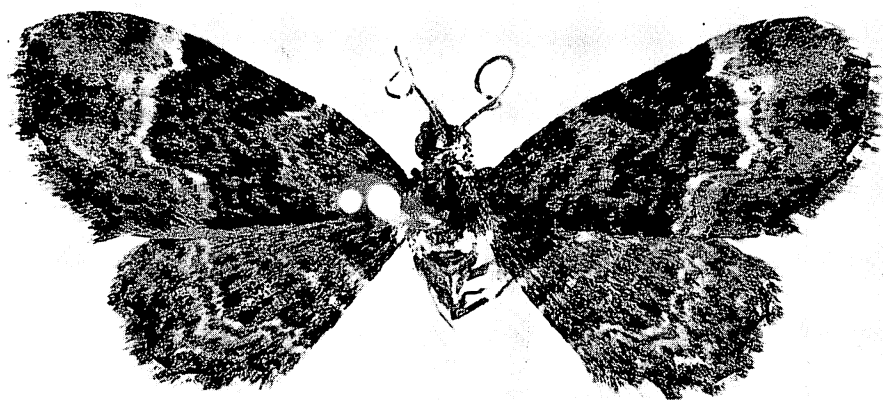


Figure 120—*Eupithecia craterias* (Meyrick). Above: Male type; Haleakala, Maui, 5,000 feet; expanse, 20 mm.; this example is figured by Prout in Seitz, vol. 12. Below: A female paratype, collected with the holotype; expanse, 16.5 mm.

**Eupithecia dryinombra** (Meyrick). (figs. 118, 119, 124, 126).

*Eucymatoge dryinombra* Meyrick, 1899:161.

*Eupithecia dryinombra* (Meyrick) Prout, 1939 (?), pl. 38.

Endemic. Molokai (type locality: above Waikolu), Hawaii.

Hostplant: Unknown.

This is a pale, narrow-winged species. The medial band on the fore wings is obscure and marked by a series of short, disconnected longitudinal dashes on the holotype. The termen is dark-edged. There are some broad, erect scales along the vein behind the cell. The antennae are furry beneath and several scales wide above. On the male holotype, palpal segments two plus three are hardly as long as an eye.

**Eupithecia monticolans** Butler (figs. 116, 117, 118, 119, 124, 125, 126, 127).

*Eupithecia monticolens* Butler, 1881:320.

*Eucymatoge monticolans* (Butler) Meyrick, 1899:164, pl. 3, figs. 3, 3a-i.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala), Lanai, Hawaii.

Hostplants: *Alphitonia ponderosa*, *Metrosideros*, *Pipturus*, *Railliardia*, *Styphelia tameiameia* (*Cyathodes*) (principal hostplant).

Parasite: *Chaetogaedia monticola* (Bigot).

The caterpillars are green.

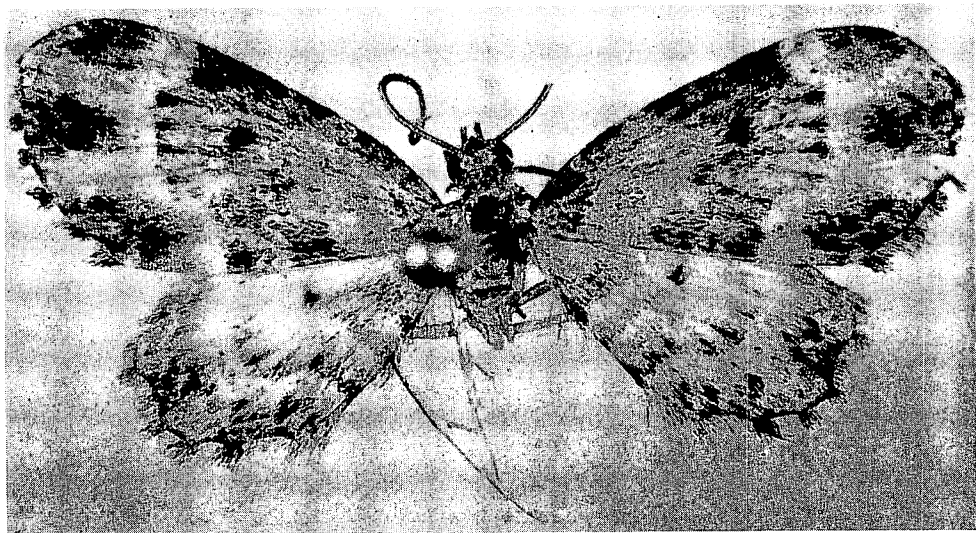


Figure 121—*Eupithecia craterias ditrecta* (Meyrick), male type; Kona, 3,500 feet; expanse, 15 mm.

This is a widespread and extremely variable moth. It would be worth while to make a careful study of the specimens assigned to this species, because more

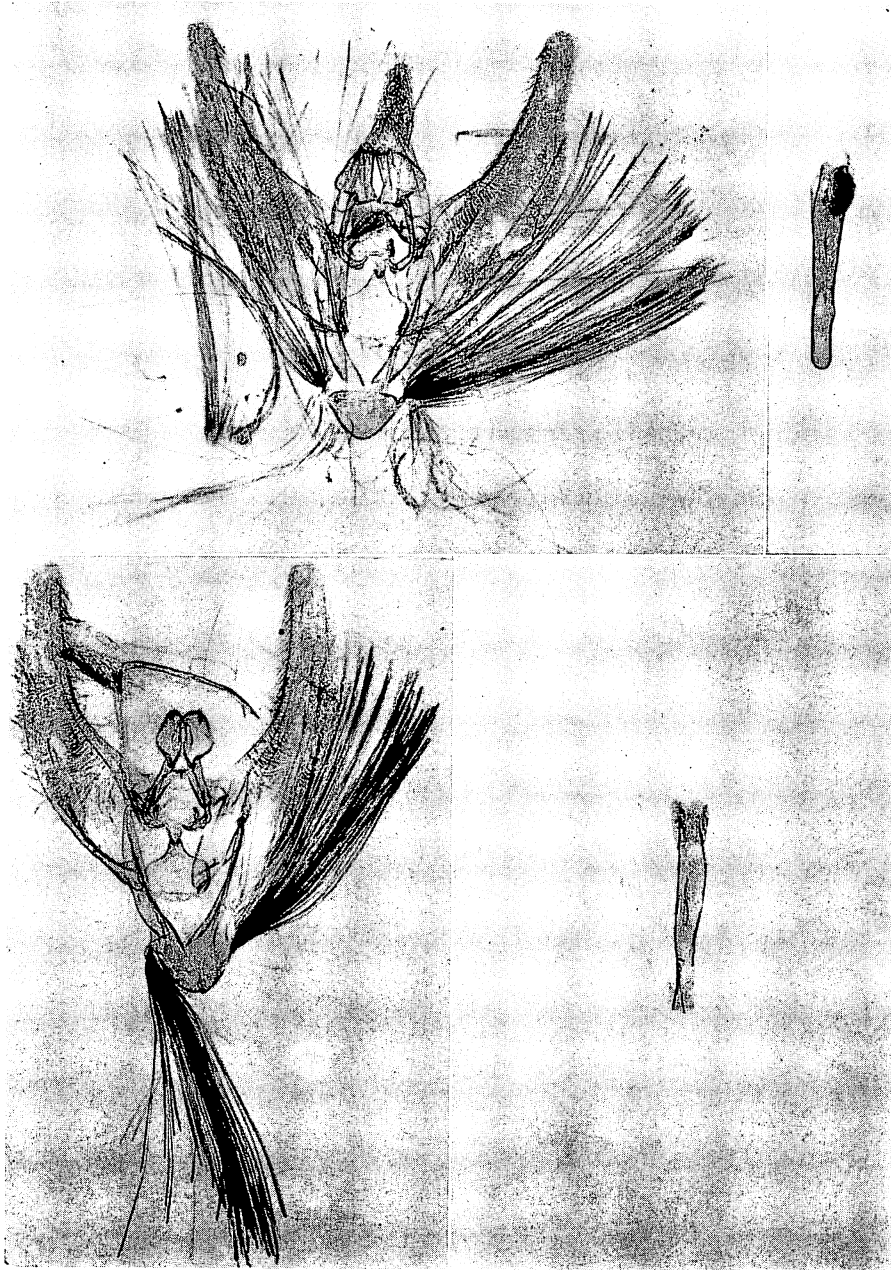


Figure 122—Male genitalia of *Eupithecia*. Above: Type of *craterias* (Meyrick); Haleakala, Maui. Below: Type of *craterias dilrecta* (Meyrick); Kona, Hawaii.

than one species may be involved. The wings have many lines, and the background scaling is usually nearly white. The color pattern is so variable that a description would be impossible to make without extensive study and segregation of numerous color forms. On the male holotype, palpal segments two plus three are one-fourth longer than the diameter of an eye, and the antennae are furry beneath and several scales wide above. Specimens may be confused with *Fletcherana insularis*.

***Eupithecia niphoreas* (Meyrick), new combination** (figs. 118, 119, 128).

*Eucymatoge niphoreas* Meyrick, 1899:162, pl. 4, fig. 19.

Endemic. Kauai (type locality: 4,000 feet).

Hostplant: Unknown.

This pretty, bright-colored species is known only from the male holotype. The orange or reddish scaling is conspicuous; the head is strikingly bicolored, with the face black and reddish scaled and the area behind the antennae white. Palpal segments two plus three are nearly equal in length to the diameter of an eye. The antennae are furry beneath and several scales wide above.



Figure 123—Female genitalia of *Eupithecia craterias* (Meyrick); Haleakala, Maui.



***Eupithecia orichloris*** (Meyrick), **new combination** (figs. 118, 119, 129, 133, 135).

*Eucymatoge orichloris* Meyrick, 1899:163, pl. 4, fig. 21.

Endemic. Kauai, Oahu, Maui, Lanai, Hawaii (type locality: Olaa).

Hostplant: *Sideroxylon*.

The green caterpillars have two elongate, backward-projecting tubercles above the anal prolegs.

In life this species is beautifully green, but all the specimens I have examined in collections have the green turned to yellow. It has the erect scales on the wings more strongly developed than any of our other species. The scales along the vein at the posterior margin of the cell are especially remarkable; they are very large, broad, erect and curled. It is strange that Meyrick made no mention of these scales. On the male holotype, palpal segments two plus three are slightly longer than an eye, and the antennae are furry beneath and several scales wide above.

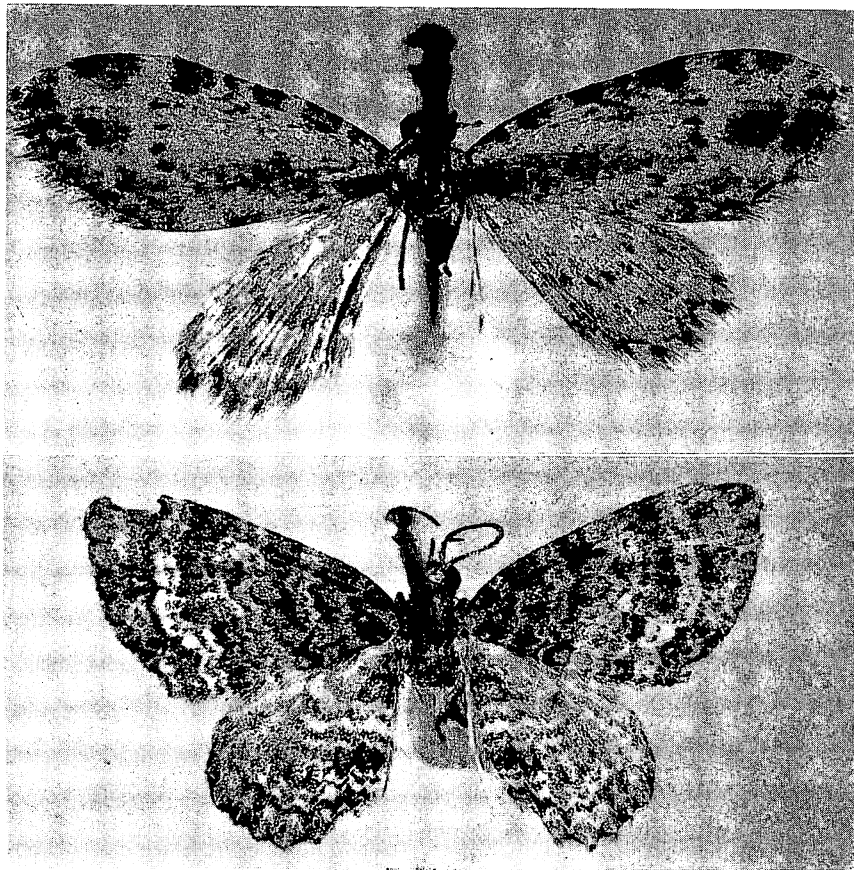


Figure 124—Above: *Eupithecia dryinombra* (Meyrick), type male; Molokai Mts., above Wai-kolu; expanse, 17 mm.; this example is figured by Prout in Seitz, vol. 12. Below: Male type of *monticolans* Butler; "Hawaiian Islands 81-7 117"; expanse, 18 mm.

**Eupithecia phaeocausta** (Meyrick) (figs. 130, 135).*Eucymatoge phaeocausta* Meyrick 1899:160.*Eupithecia phaeocausta* (Meyrick) Prout, 1939 (?), pl. 38.

Endemic. Molokai (type locality: forest above Pelekunu).

Hostplant: Unknown.

This is a small, dark, narrow-winged, obscurely marked species. On the holotype, palpal segments two plus three are shorter than the diameter of an eye. On the female the antennae are furry beneath and several scales wide above, but on the male they are long-furry all around, as in *scoriodes*, and they have only a narrow dorsal line of scaling.

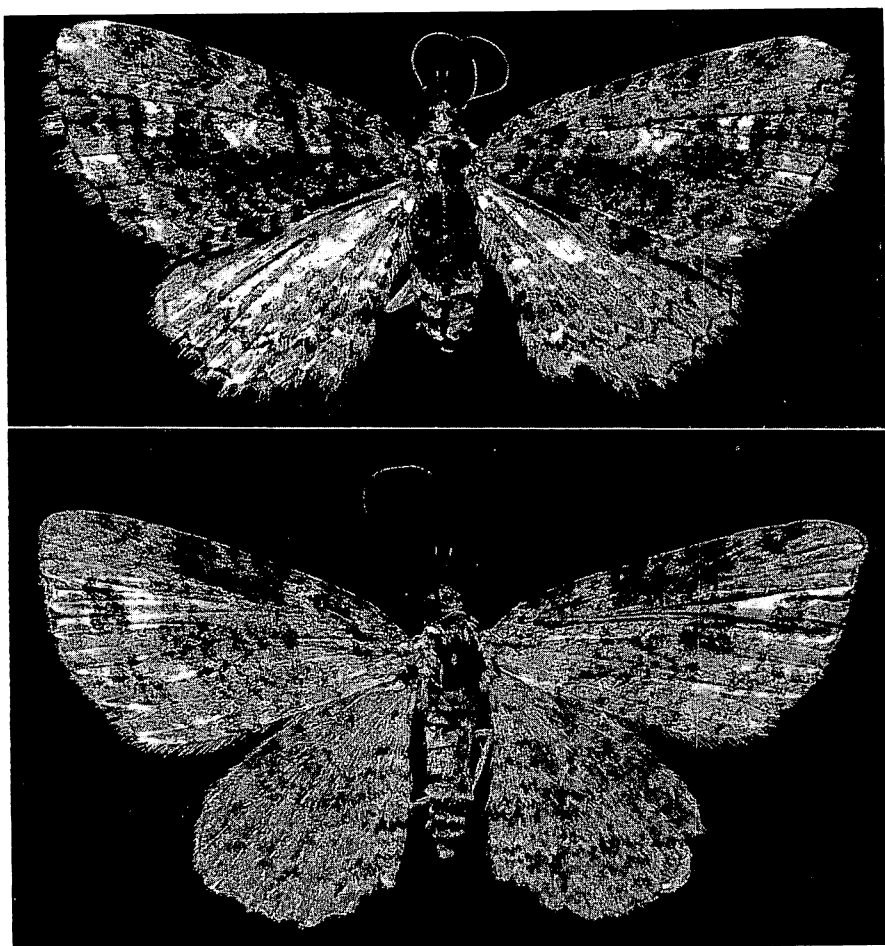


Figure 125—*Eupithecia monticolans* Butler. Two females from Kilauea, Hawaii; fore wing length, 13 mm. on each specimen.

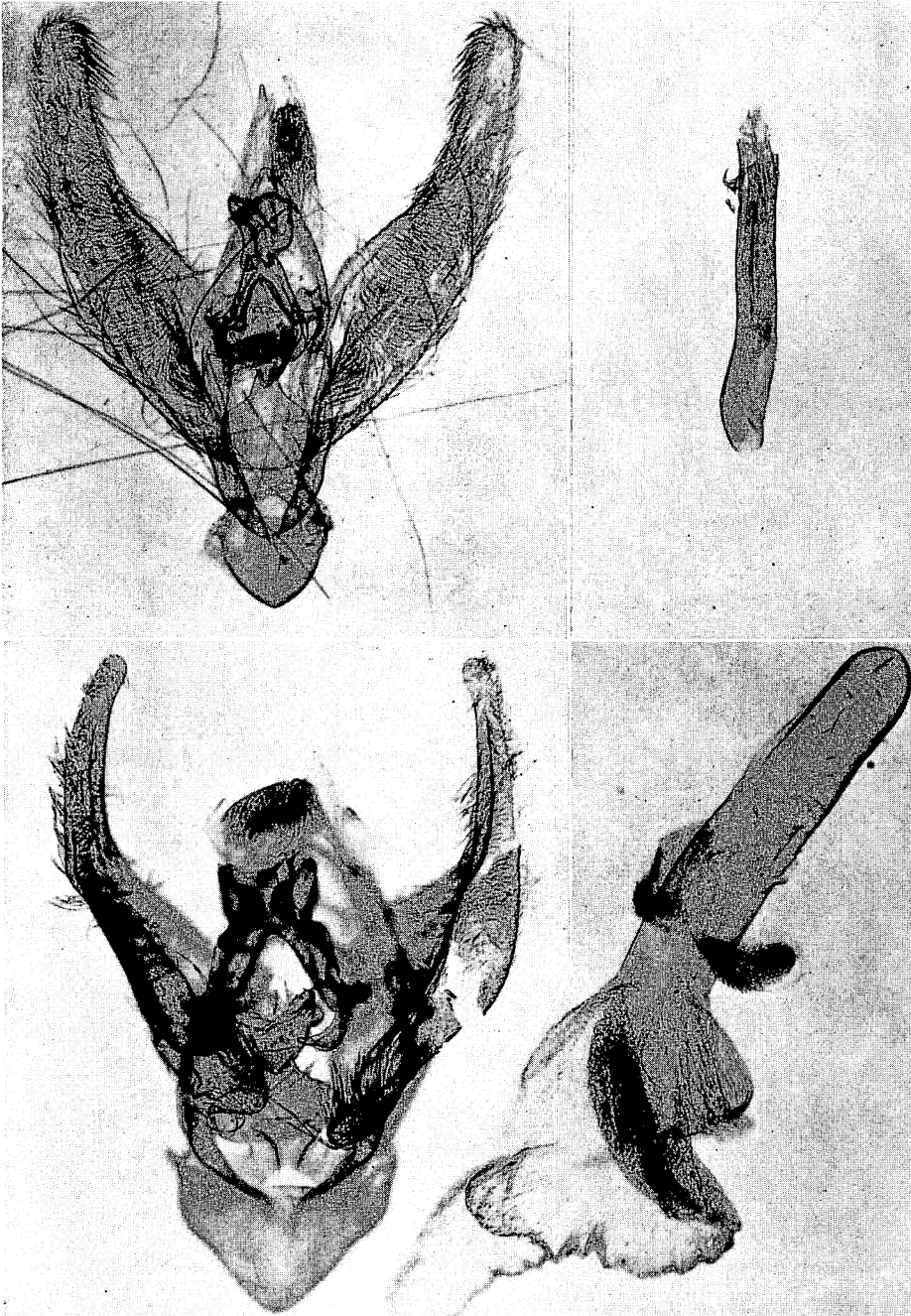


Figure 126—Male genitalia of *Eupithecia*. Above: The type of *dryinombra* (Meyrick). Below: The type of *monticolans* Butler (aedeagus and remainder of genitalia to same scale).

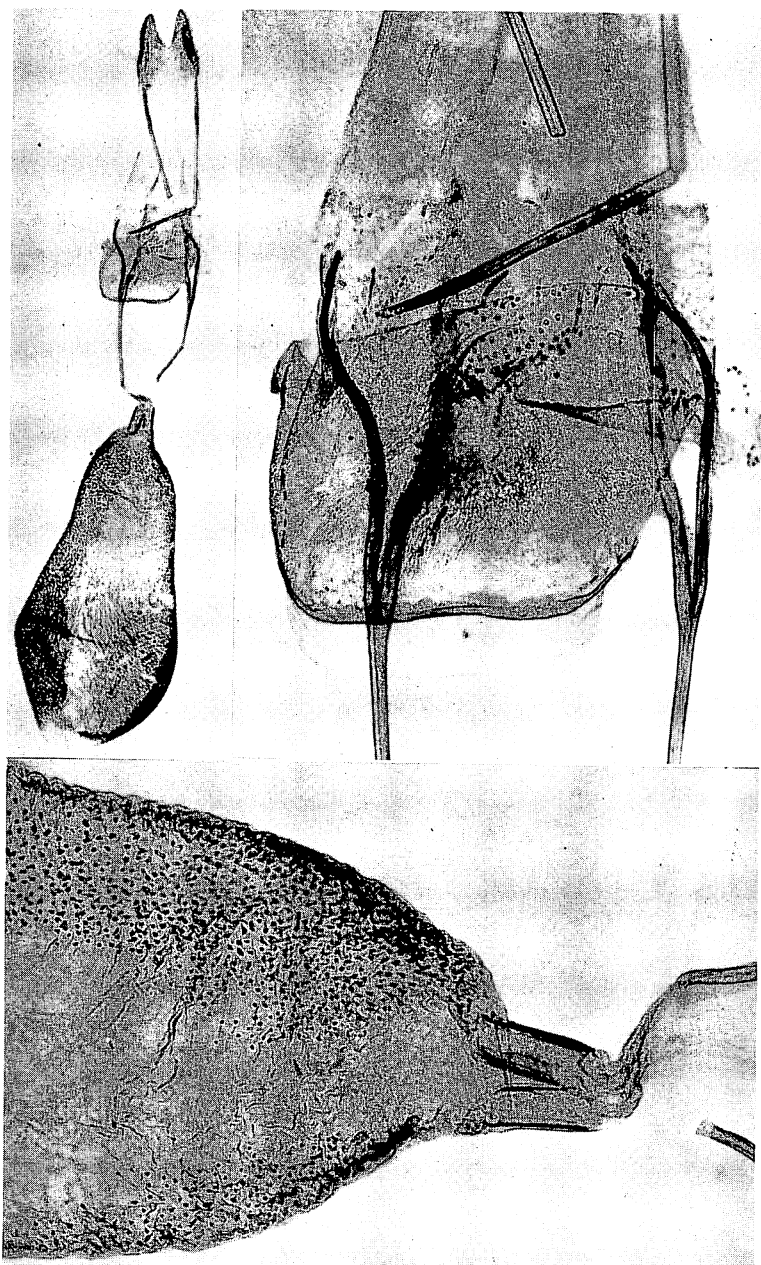


Figure 127—Female genitalia of *Eupithecia monticolans* Butler; Haleakala, Maui.

***Eupithecia prasinombra*** (Meyrick) (fig. 130).

*Eucymatoge prasinombra* Meyrick, 1899:162.

*Eupithecia prasinombra* (Meyrick) Prout, 1939 (?), pl. 38.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Unknown.

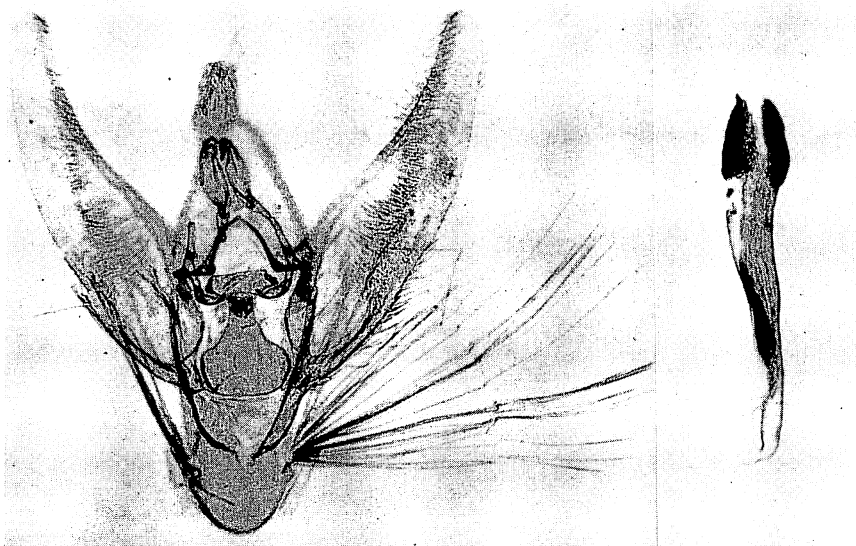


Figure 128—*Eupithecia niphoreas* (Meyrick), type male; Kauai, 4,000 feet; expanse, 16 mm.; and genitalia.

This is another species which may be confused with some of the forms of *monticolans*. Meyrick described it as green, but the unique female type must be very much bleached, because there are no greenish scales on it now. There are some pale cream-colored areas only. A number of the scales are orange- or rosy-tipped. The discal spot is distinct above and below in both pairs of wings. On the holotype, palpal segments two plus three are slightly shorter than an eye; the antennae are furry beneath and several scales wide above.

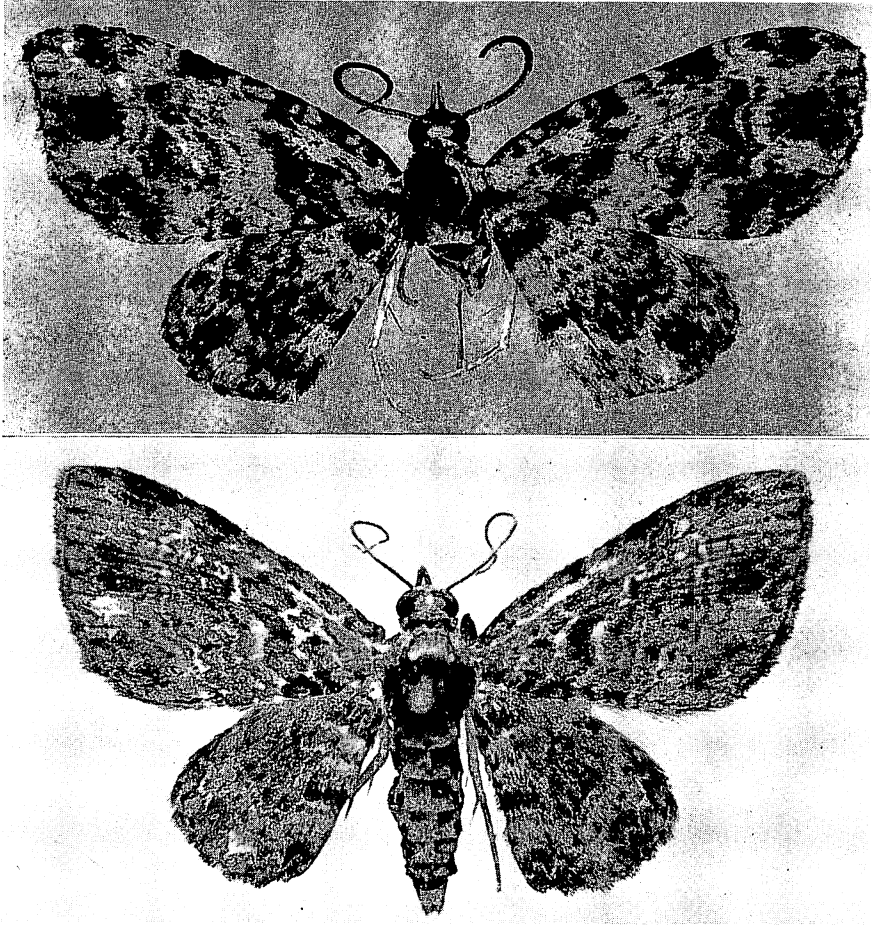


Figure 129—Above: *Eupithecia orichloris* (Meyrick), type male; Olaa, Hawaii; expanse, 23.5 mm. Below: A female from Puu Peahinaia, Hawaii; expanse, about 23 mm.



***Eupithecia rhodopyra* (Meyrick), new combination** (figs. 131, 135).

*Eucymatoge rhodopyra* Meyrick, 1899:162, pl. 4, fig. 20.

Endemic. Kauai (type locality: 4,000 feet).

Hostplant: Unknown.

This is one of the most distinct of all our *Eupithecia*. The dull reddish coloration and the form and angulation of the medial bands of both pairs of wings are characteristic and unlike any other species in Hawaii. On the holotype, palpal segments two plus three are one-fourth longer than an eye, and the antennae are very short-furry beneath and several scales wide above.

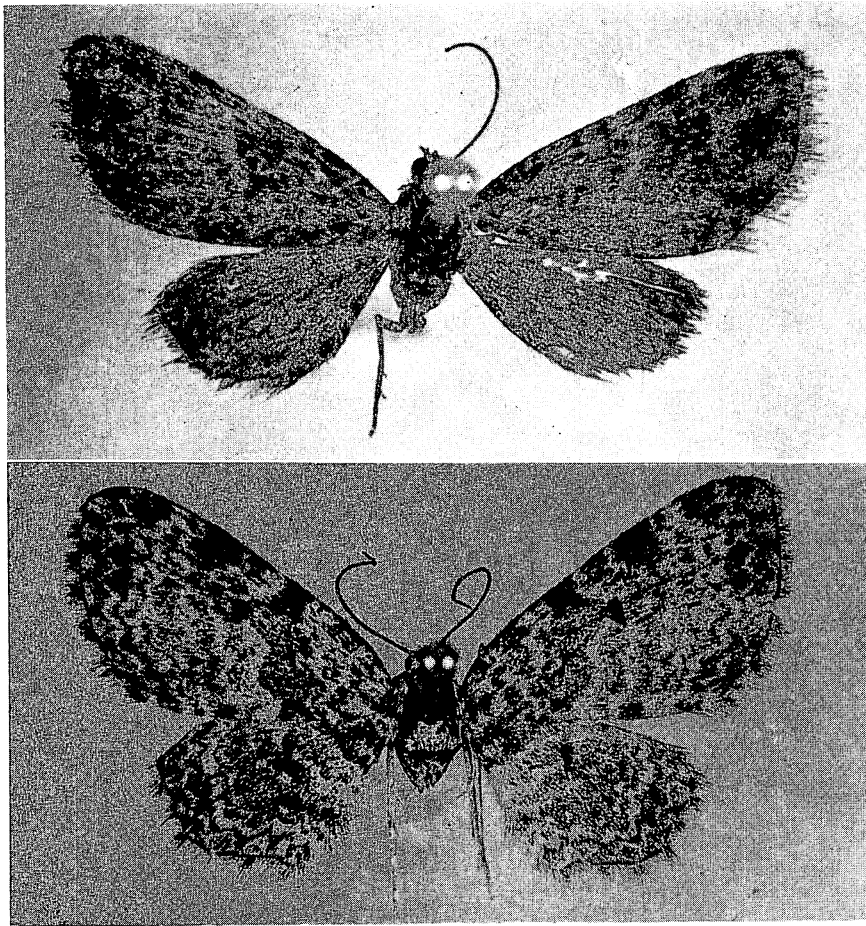


Figure 130—Above: *Eupithecia phaeocausta* (Meyrick), type female; forest above Pelekunu, Molokai; expanse, 16 mm.; figured by Prout in Seitz, vol. 12. Below: Female type of *prasinombra* (Meyrick); Haleakala, Maui, 5,000 feet; expanse, 19 mm.; figured by Prout in Seitz, vol. 12.

***Eupithecia scoriodes* (Meyrick), new combination** (figs. 118, 119, 131, 133).  
*Eucymatoge scoriodes* Meyrick, 1899:160, pl. 4, fig. 7.

Endemic. Maui (type locality: Haleakala, 7,000 to 8,000 feet).

Hostplant: Unknown.

This dark, nearly black species is one of our smaller, narrow-winged forms. It is much like *phaeocausta*, but the markings are much more definite. On the male holotype, palpal segments two plus three are subequal in length to an eye, and the antennae are unusual, because they are very long-furry above as well as beneath, and there is only a narrow line of dorsal scaling (compare *phaeocausta*).

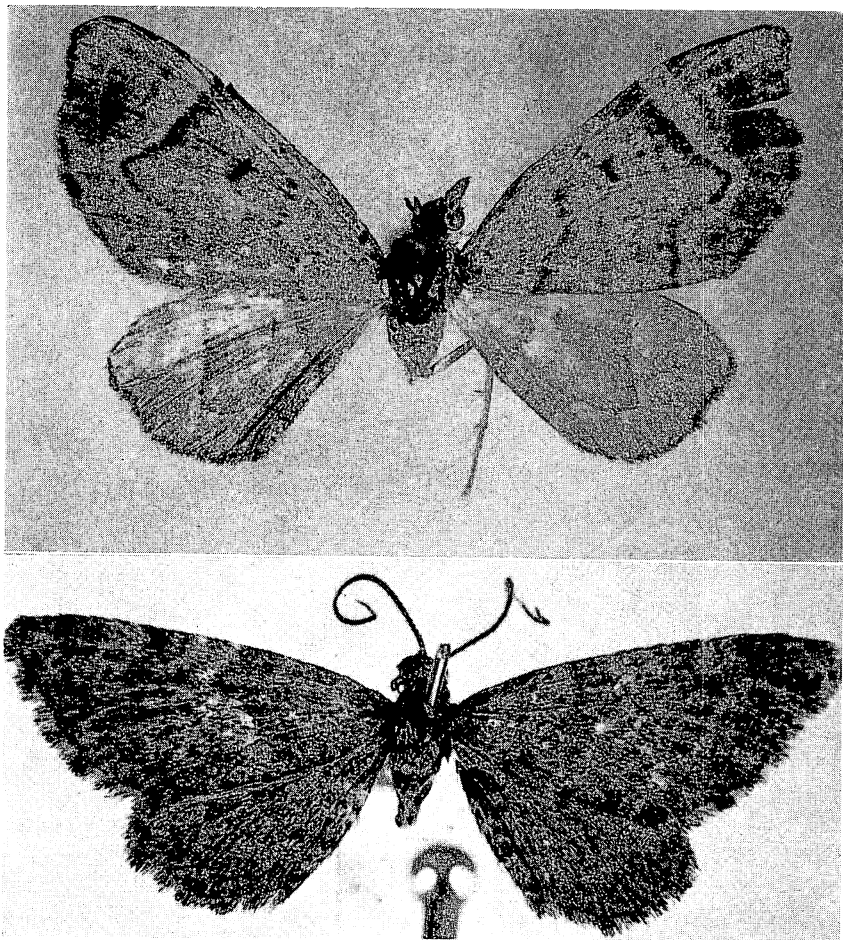


Figure 131—Above: *Eupithecia rhodopyra* (Meyrick), female type; Kauai, 4,000 feet; expanse, 19.5 mm. Below: Male type of *scoriodes* (Meyrick); Haleakala, 7,000–8,000 feet; expanse, 15 mm.



***Eupithecia staurophragma* (Meyrick), new combination** (figs. 118, 119, 132, 134).

*Eucymatoge staurophragma* Meyrick, 1899:161, pl. 4, fig. 8.

Endemic. Maui, Hawaii (type locality: Kona, over 2,000 feet).

Hostplant: Unknown.

The unusual shape of the hind wings serves as an easy method of separating this species from all of our other species. It is highly variable in color pattern. The male holotype has palpal segments two plus three slightly shorter than the diameter of an eye, and the antennae are long-furry beneath and several scales wide above.

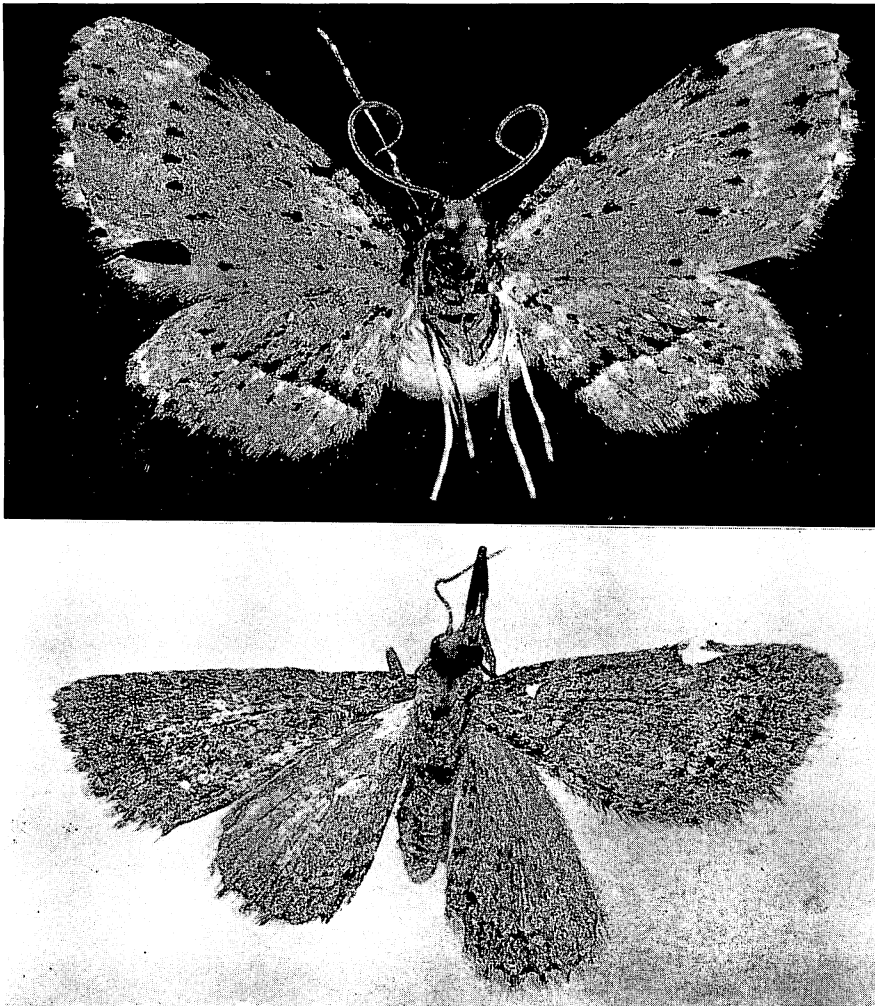


Figure 132—Above: *Eupithecia staurophragma* (Meyrick), male type; Kona, 2,000 feet; expanse, 20.5 mm. Below: The female type of *stypheliae* (Swezey); Kilauea Iki Trail, Hawaii; fore wing, 9 mm. long.

***Eupithecia stypheliae*** (Swezey), **new combination** (figs. 132, 136).  
*Eucymatoge stypheliae* Swezey, 1948:259.

Endemic. Hawaii (type locality: Kilauea Iki trail).  
Hostplant: *Styphelia tameiameia*.

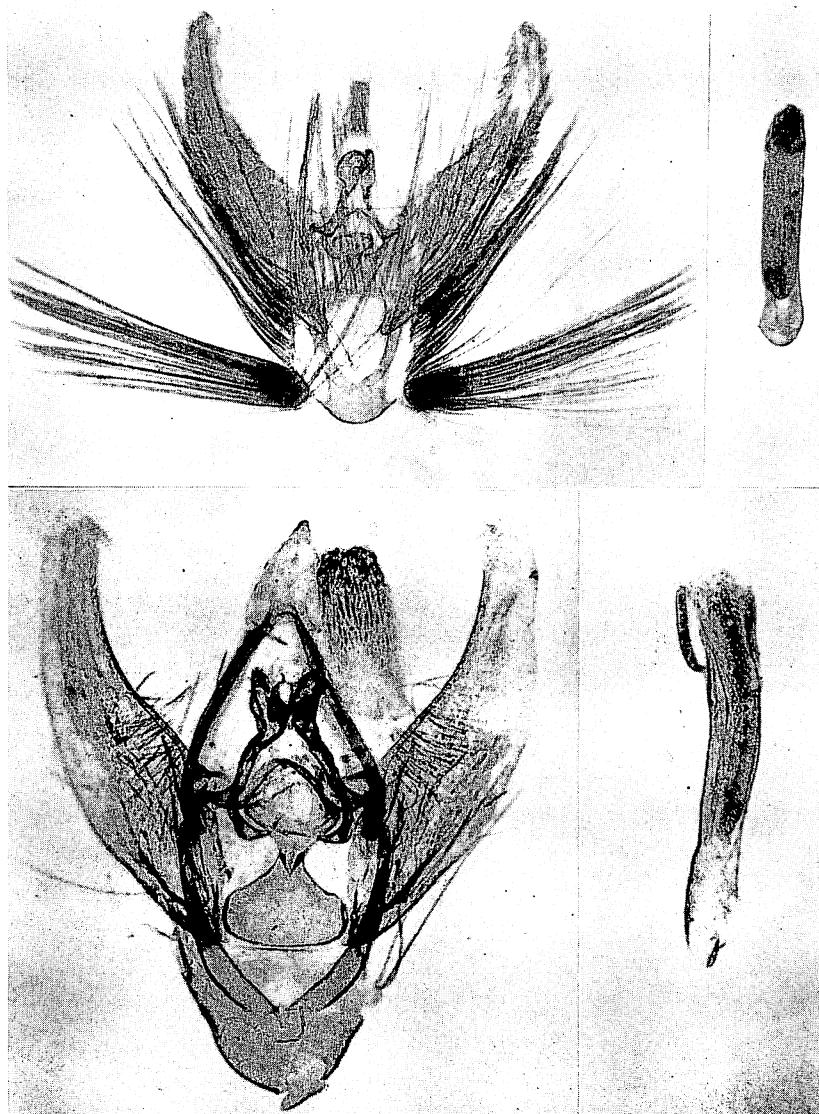


Figure 133—Above: Male genitalia of *Eupithecia orichloris* (Meyrick), type; Olaa, Hawaii.  
Below: Of type of *scoriodes* (Meyrick); Haleakala, 7,000–8,000 feet.

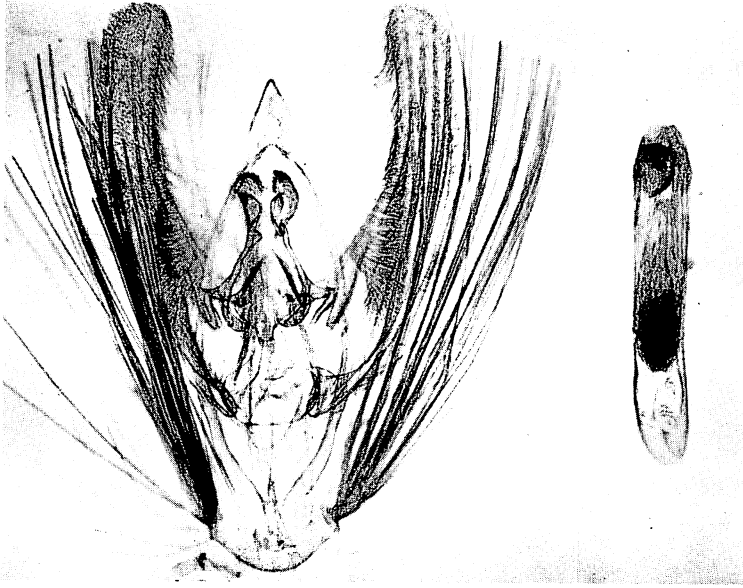


Figure 134—Male genitalia of the type of *Eupithecia staurophragma* (Meyrick); Kona, Hawaii.

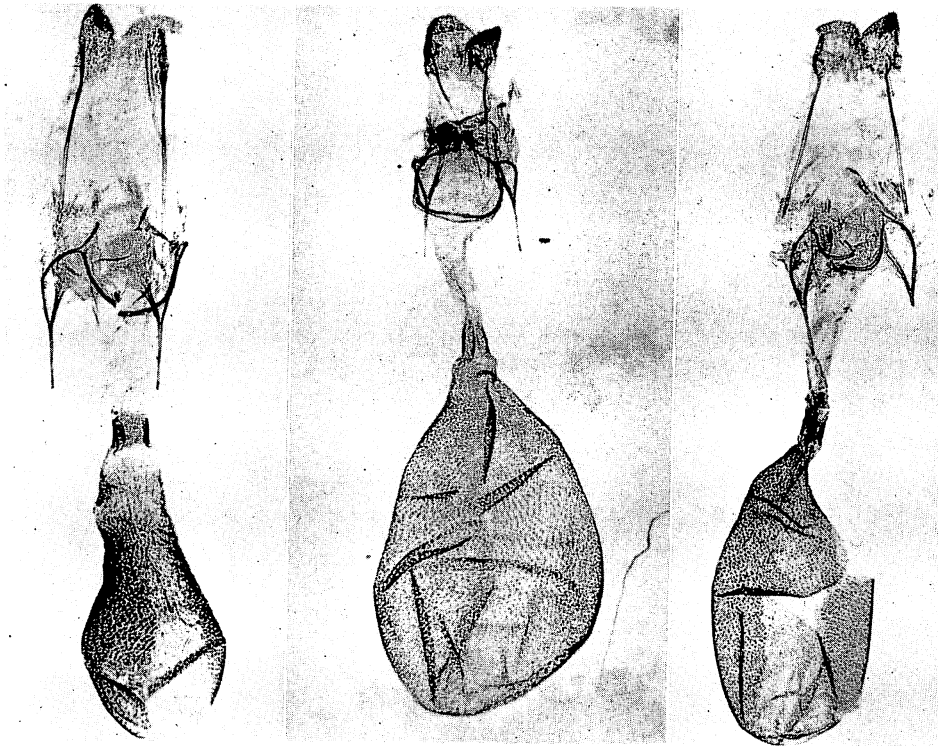


Figure 135—Left: Female genitalia of *Eupithecia phaeocausta* (Meyrick), type; Molokai Mts. Center: Of *orichloris* (Meyrick); Olaa, Hawaii. Right: Of *rhodopyra* (Meyrick); Kauai.

This species is known only from the female holotype reared by Dr. Swezey. No island was mentioned in the original description, but the type locality is on the Island of Hawaii. Because the type is in Honolulu and this text was written in London, I am unable to include comparative notes on the species at this time.

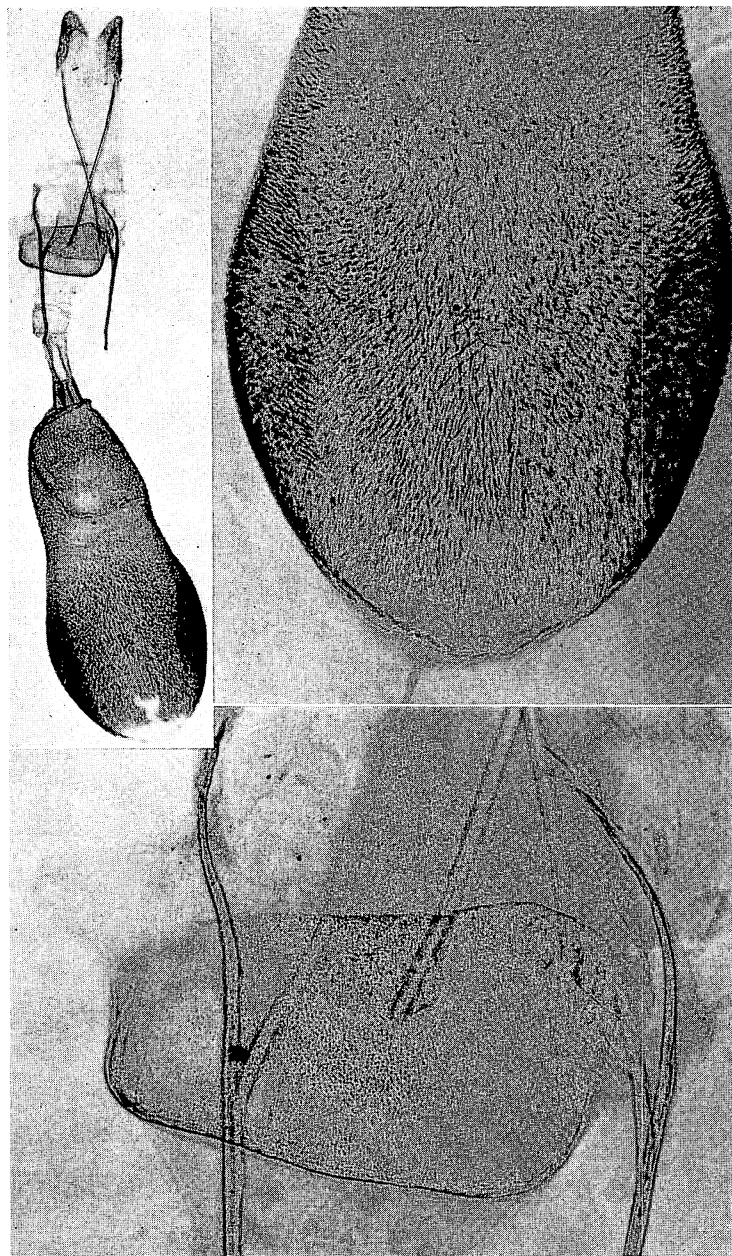


Figure 136—Female genitalia of the type of *Eupithecia stypheliae* (Swezey); Kilauea Iki Trail, Hawaii.

Genus **FLETCHERANA**, new genus

Antennae simple and not pectinate in either sex. Head and palpi as figured. Wings and venation as figured; color patterns well developed; marginal crenulations at most feeble. Male and female genitalia as illustrated; uncus well developed; valves with fine hair and no clusters of spines.

In this genus, and also in *Progonostola* and *Megalotica*, the males have well-developed subapical tufts of hair on the abdomen.

Type: *Larentia insularis* Butler. Gender of *Fletcherana*: feminine.

This is an endemic cluster of species, the origin of which is unknown. However, it may be associated with the other endemic genera, *Progonostola* and *Megalotica*. The scales on the fronts of the heads of all of the species are whorled into a peak, except for the anomalous *ioxantha* on which they are flatly appressed (see the notes under that species). The male genitalia of the species (with the exception of *ioxantha*, no males of which have been seen) are so similar that it might at first appear that fewer than the five good species included here are involved; this has been an unexpected discovery. Further study, especially of reared material, is desired.

It gives me the greatest of pleasures to dedicate this new genus to my friend, D. S. Fletcher, expert on the Geometridae, British Museum (Natural History), as a small token of my deep appreciation for the extensive and invaluable assistance he has most cheerfully given to me during the writing of this text.

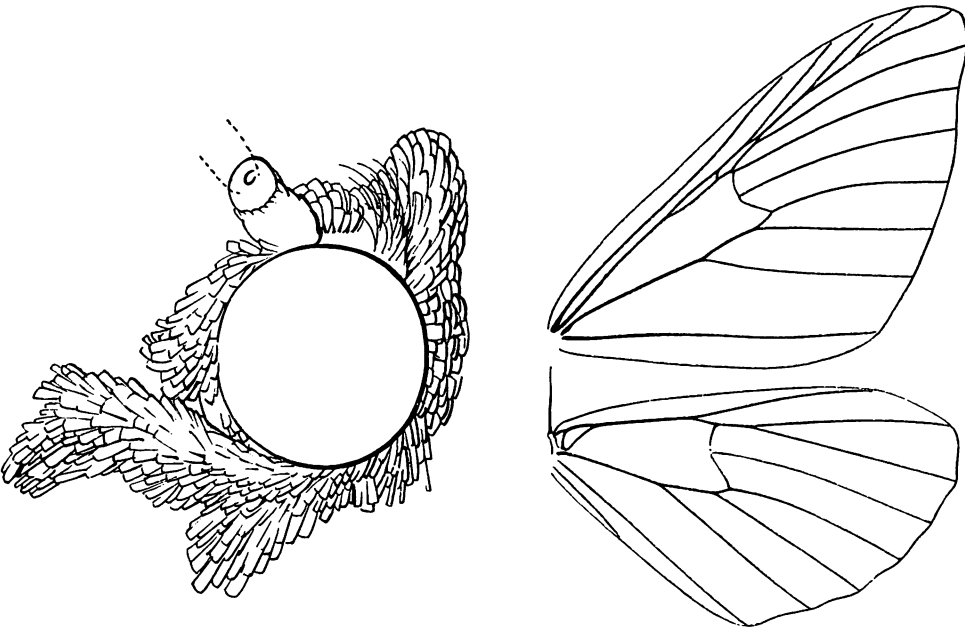


Figure 137—Head (left) and wing venation (right) of *Fletcherana insularis* (Butler).

KEY TO THE SPECIES OF FLETCHERANA

- 1. Fore wings conspicuously pointed at apex; body and wings with extensive yellow and orange scaling; discal spots well developed in all wings above and below; termen of both fore and hind wings broadly dark-colored; outer margin of medial band produced into many points; scales on front of head all closely appressed, not forming a peak; genae bare.....*ioxantha* (Meyrick).  
Not so; scales on frons whorled into a peak.....2
- 2(1). Medial band of fore wing nearly straight; subbasal band not reaching costa, prominently defined and dark outlined.....*giffardi* (Swezey).  
Medial band of fore wing conspicuously angulate and produced distad in middle.....3
- 3(2). Scaling grey, white and fuscous, without extensive yellow, orange or pink scaling; gena with a row of scales.....*insularis* (Butler).  
Wings, and in some specimens body also, with extensive yellow, orange or pink scaling, in addition to the white and dark scaling.....4

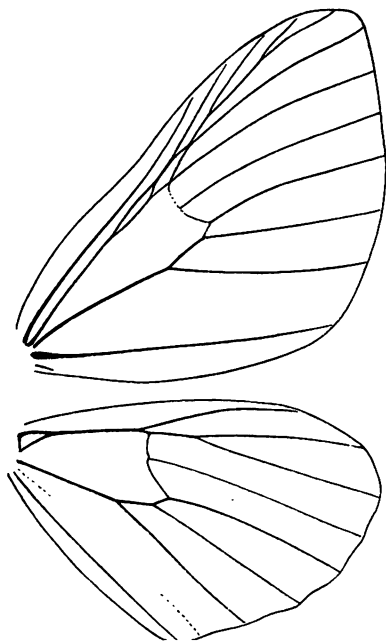


Figure 138—Wing venation of *Fletcherana leucoxyia* (Meyrick).

- 4(3). With considerable pink scaling; fore wing with medial band strigulated with numerous lines, without a dark patch between veins six and seven; terminal lines on both wings well marked with patches of dark scales. . . . . **roseata** (Swezey).  
 With considerable yellow scaling; fore wing with a well-defined, subapical dark patch between veins six and seven, medial band without numerous lines; terminal line on both pairs of wings not strongly dark-marked . . . . . **leucoxyia** (Meyrick).

**Fletcherana giffardi** (Swezey), **new combination** (figs. 139, 145, 147).  
*Hydriomena giffardi* Swezey, 1913:271.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

The unique type is in Honolulu, and I have not had it available while preparing the final draft of this book.

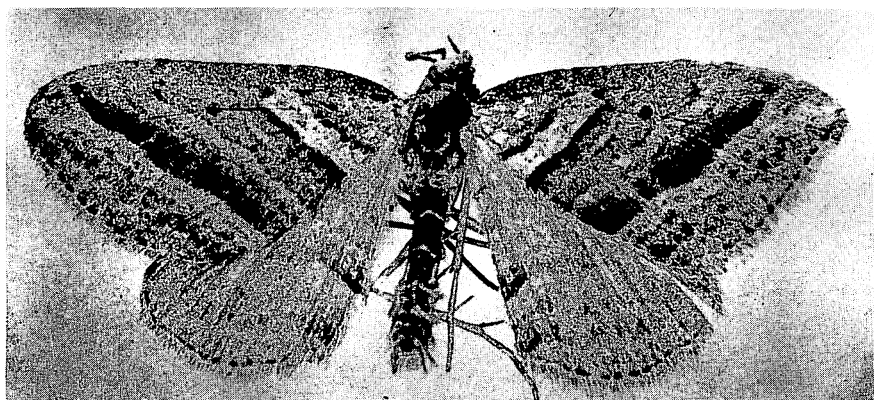


Figure 139—Male type of *Fletcherana giffardi* (Swezey); Kilauea, Hawaii; fore wing length, 11.5 mm.

**Fletcherana insularis** (Butler), **new combination**. Type of *Fletcherana* (figs. 137, 140, 141, 147.).

*Larentia insularis* Butler, 1879:272.

*Xanthorhoe insularis* (Butler) Meyrick, 1899:166. Prout, 1939:258, pl. 25.

Endemic. Maui (type locality: Haleakala; the holotype bears Blackburn's numbers "79-8" and "63").

Hostplant: Unknown.

This is a variable species in size, color and pattern. It has been found above the forest belt, high up on Haleakala. Some examples might be mistaken for *Eupithecia monticolans* which it somewhat resembles in color and markings, but, as the figures show, the wing shape and course of the medial band and other markings

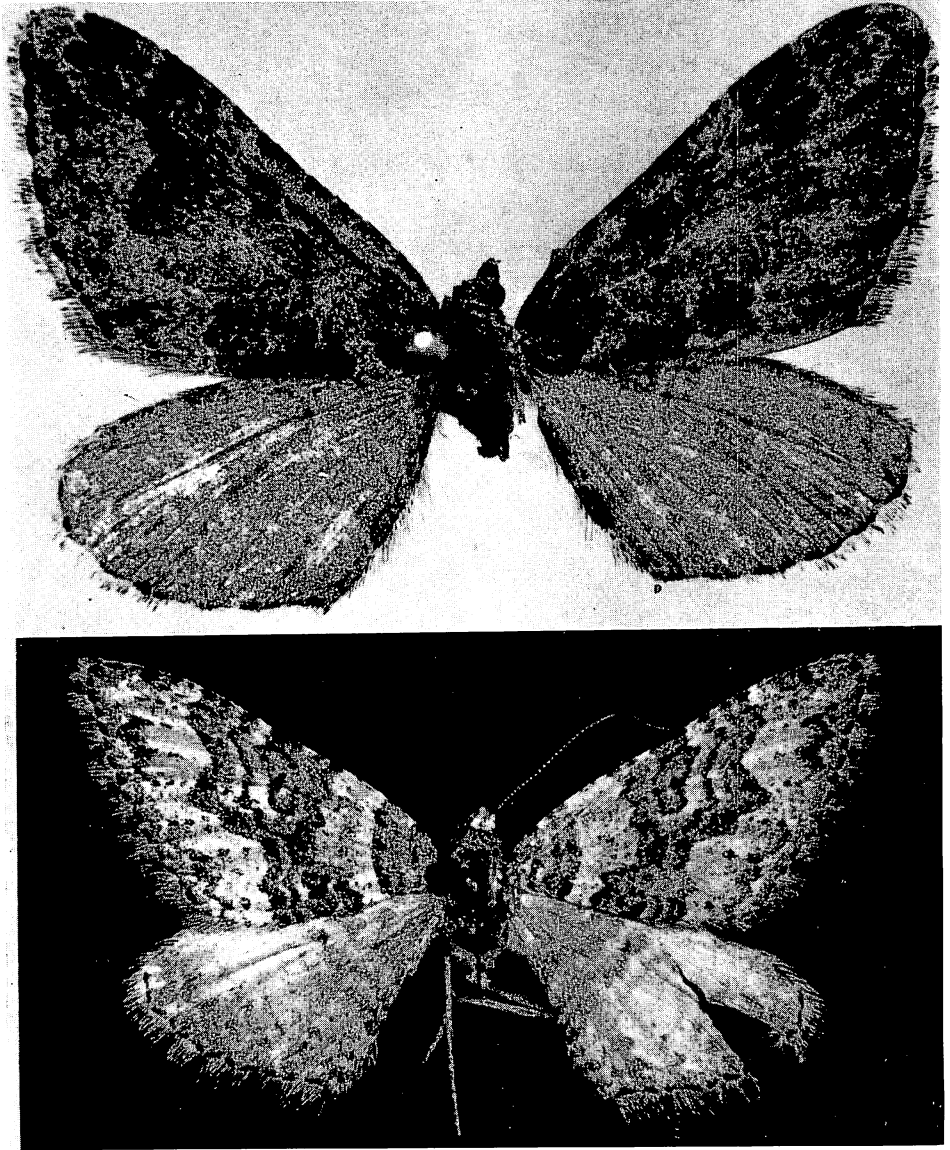


Figure 140—Above: *Fletcherana insularis* (Butler), male type; "Sandw. Isd. 79.8 No. 63" (from Haleakala, Maui); expanse, 30 mm.; figured by Prout in Seitz, vol. 12. Below: A female from Haleakala, Maui, 6,000 feet; expanse, 23.5 mm.



are distinct. The second plus third palpal segments are one-sixth longer than the diameter of an eye. The antennal segments near the twelfth segment are about one-sixth longer than broad; on the under side of the segments in the male there are some hairs which are nearly as long as the breadths of the segments.

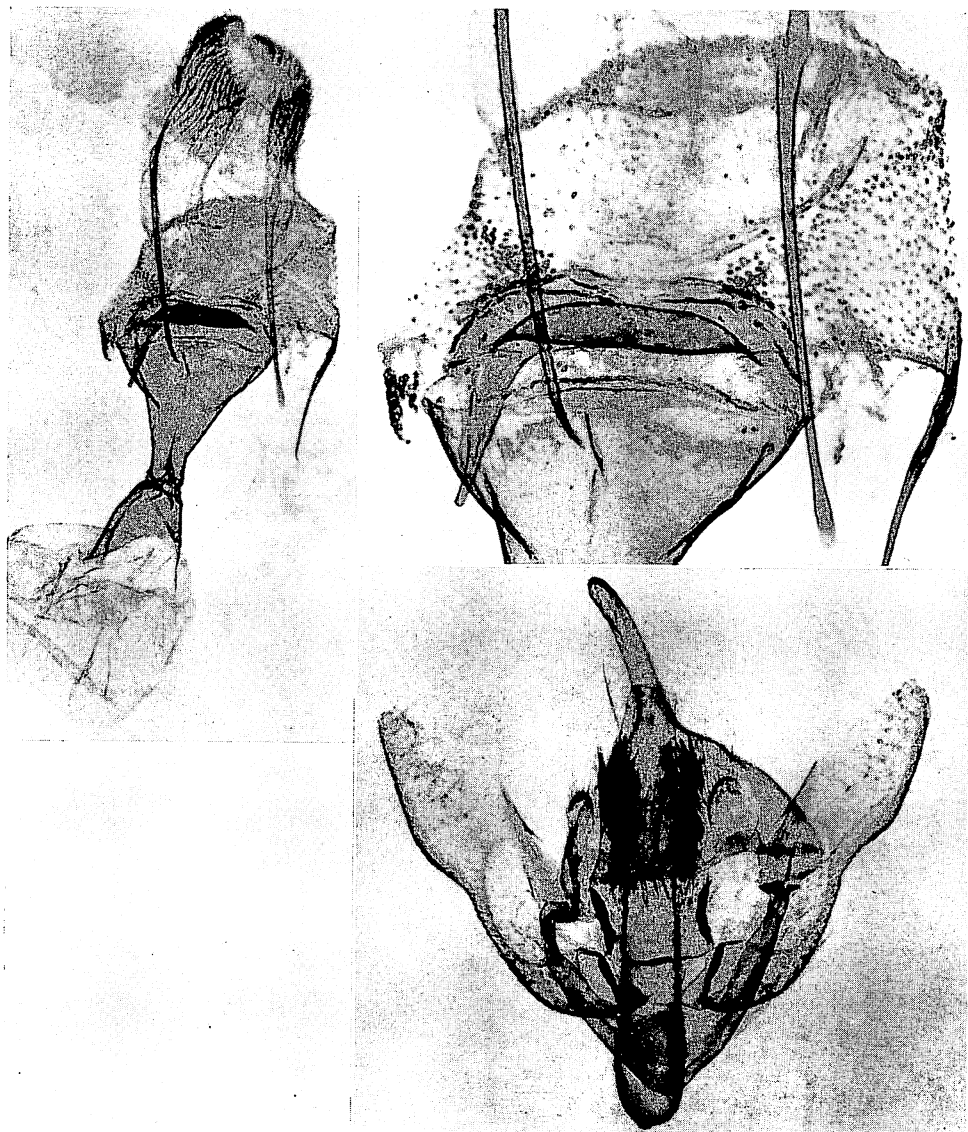


Figure 141—*Fletcherana insularis* (Butler). Above: Female genitalia from a specimen from Haleakala, Maui. Below: Male genitalia of type; from the same locality.

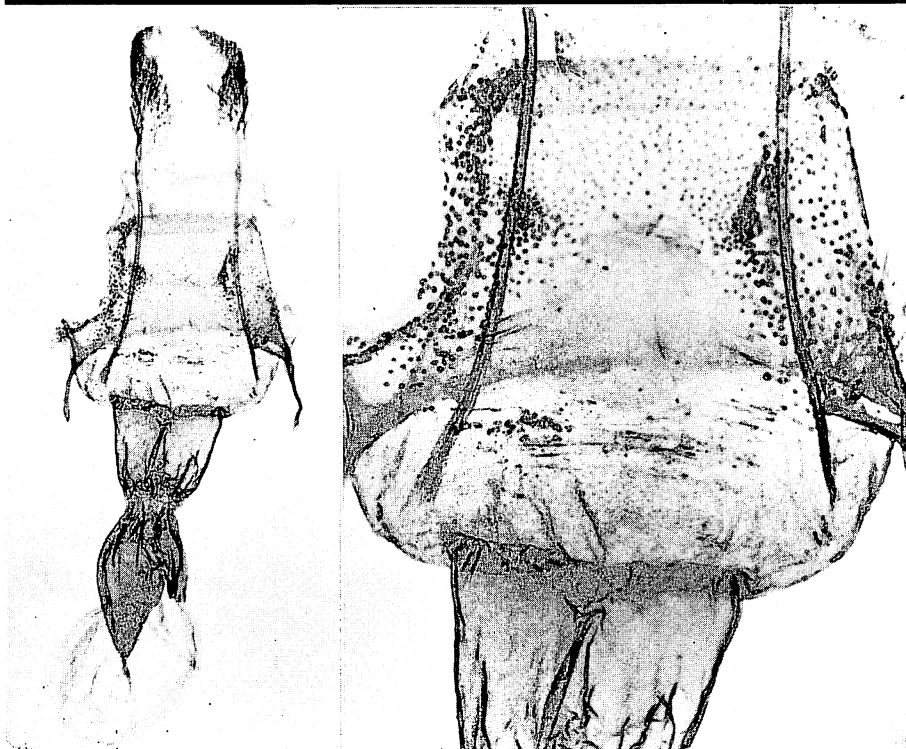
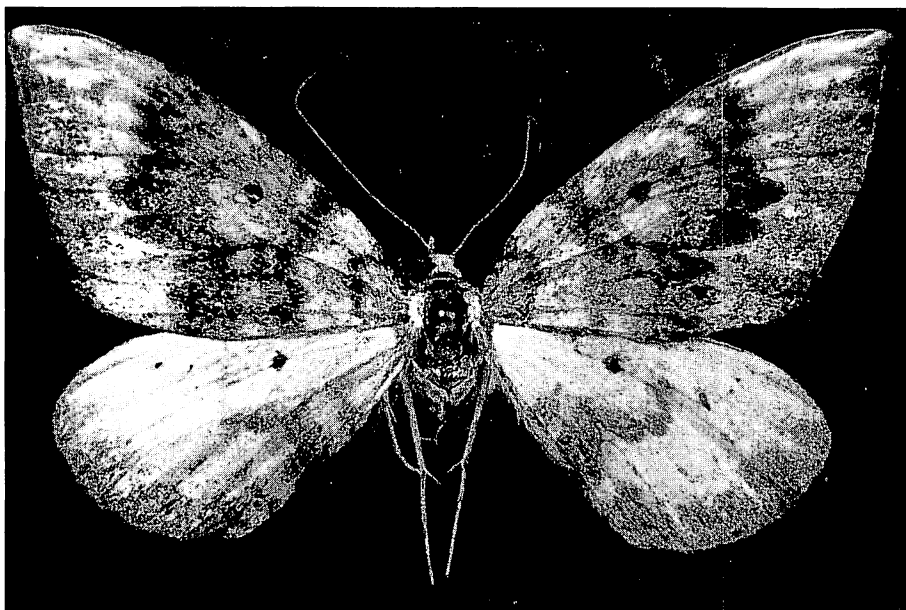


Figure 142—*Fletcherana ioxantha* (Meyrick), female type; Kaholuamano, Kauai, 4,000 feet; expanse, 29 mm. Genitalia below.

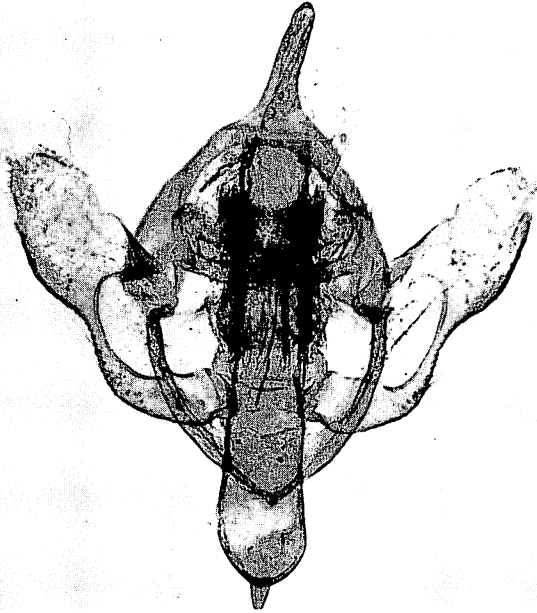


Figure 143—*Fletcherana leucoxylla* (Meyrick); Kokee, Kauai; fore wing length, 14.5 mm.; and genitalia.

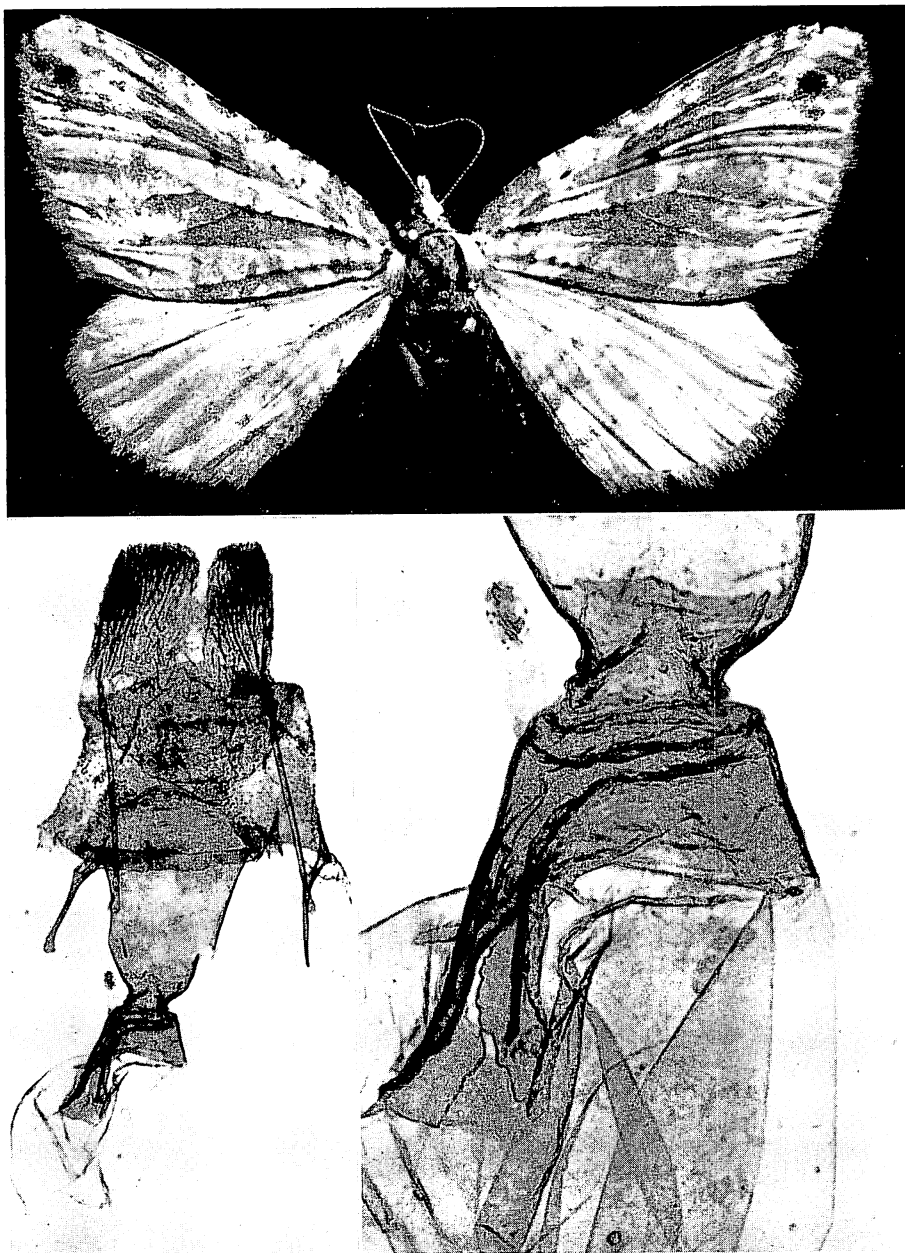


Figure 144—*Fletcherana leucoxylla* (Meyrick), female type, and genitalia; Waimea Mts., Kauai, 4,000 feet; expanse, 30.5 mm. In the photograph the medial band is not clearly defined on the wings because of lack of contrast in color.

**Fletcherana ioxantha** (Meyrick), **new combination** (figs. 142).

*Xanthorhoe ioxantha* Meyrick, 1899:165, pl. 4, fig. 23. Prout, 1939:258, pl. 25.

Endemic. Kauai (type locality: Kaholuamano, 4,000 feet).

Hostplant: Unknown.

This is a beautiful and rare species known only from the unique female holotype in the British Museum. The large amount of orange and yellow scaling, the

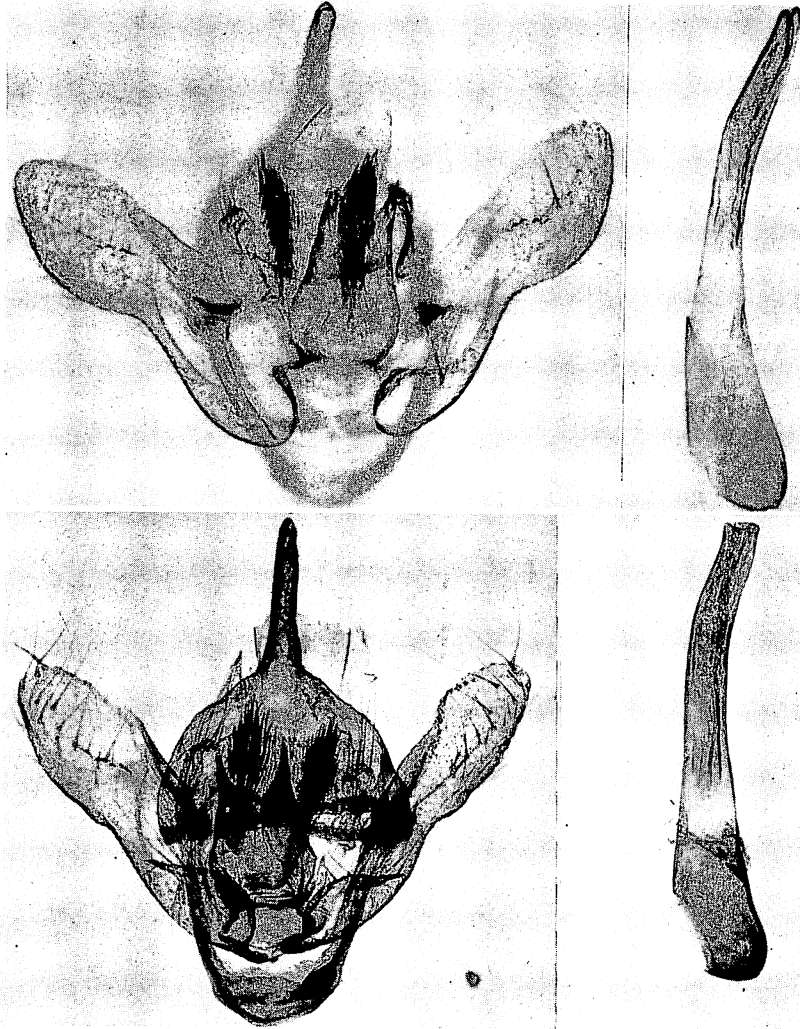


Figure 145—Above: Male genitalia of *Fletcherana giffardi* (Swezey), type; Olaa, 29 Miles, Hawaii. Below: Of *roseata* (Swezey), type from Kilauea, Hawaii.

strongly multidentate outer margin of the medial band and pointed fore wings are distinctive features. The scaling is flat over the entire face, and it is not drawn out into a peak or erected in front as it is on the other species. Palpal segments two plus three are somewhat more than one-fourth longer than the diameter of an eye. The antennal segments in the vicinity of the twelfth segment are about twice as long as broad in the female type. This is an unusual species, and additional specimens are desired for study; the male is especially wanted. It may not be a member of this genus.

**Fletcherana leucoxya** (Meyrick), **new combination** (figs. 138, 143, 144, 147).

*Xanthorhoe leucoxya* Meyrick, 1899:166.

*Hydriomena leucoxya* (Meyrick), Meyrick, 1928:94.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet).

Hostplant: Unknown.

The background coloration is nearly white; the intensity of the markings varies considerably. On the specimens examined, the discal spot is obsolete on the dorsal surface of the hind wings, but it is developed on the under sides of all wings. The scales on the anterior half of the front of the head are roughly erected. The antennal segments at about the twelfth segment are about as long as broad in both sexes. The second plus the third palpal segments are about one-fourth longer than the diameter of an eye.

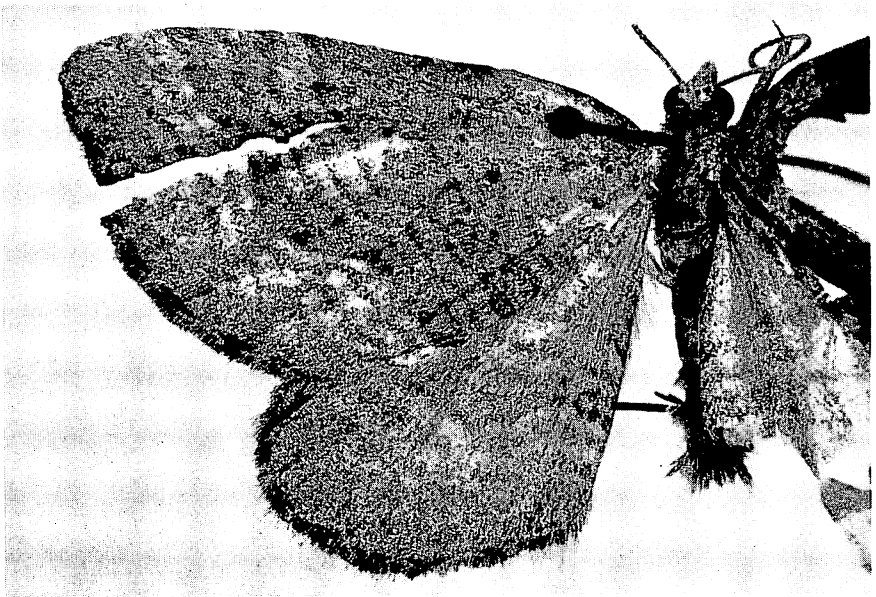


Figure 146—Male type of *Fletcherana roseata* (Swezey); Kilauea, Hawaii; fore wing length, 14 mm.

**Fletcherana roseata** (Swezey), new combination (figs. 145, 146, 147).*Hydriomena roseata* Swezey, 1913:271.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

The unique type is in Honolulu and has not been available during the writing of the final draft of this text.

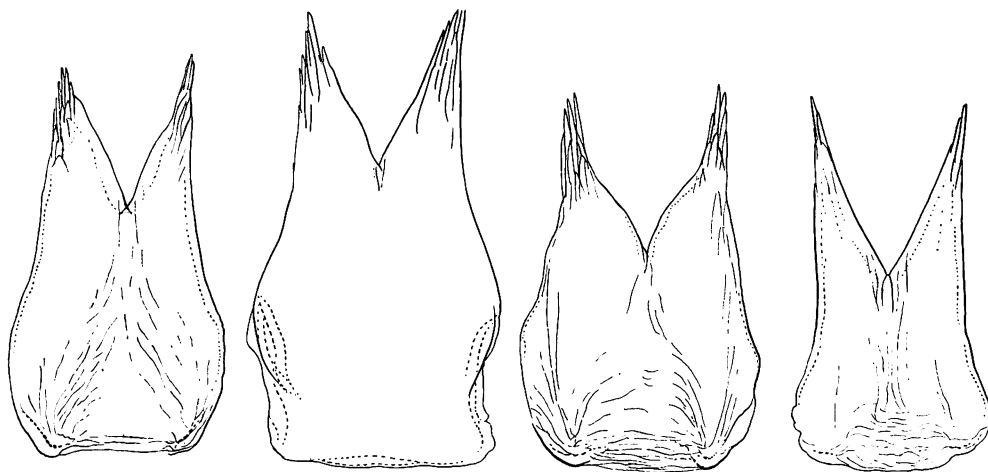


Figure 147—The juxta of the male genitalia in: *Fletcherana giffardi* (Swezey), type; *insularis* (Butler), type; *roseata* (Swezey), type; a specimen of *leucoxyia* (Meyrick) from Kauai. It is not known whether the apparent differences here displayed are specific or individual; additional material is required for study.

Genus **PROGONOSTOLA** Meyrick, 1899:167

This is an endemic genus in which I now establish two subgenera:

Subgenus **PROGONOSTOLA**, sensu stricto

The male is easily recognized because of the unusual unipectinate antennae. The head, palpi, wings, venation and genitalia are as figured. The scales on the front of the head are prostrate, not erected, and they are drawn together to form a pointed process projecting over the base of the proboscis. The wing margins are strongly crenulate. In the male genitalia, the uncus is absent, the juxta bears a pair of setose processes, and each valve bears a large distal patch of dense spines.

Type: *Progonostola cremnopsis* Meyrick. Gender feminine.

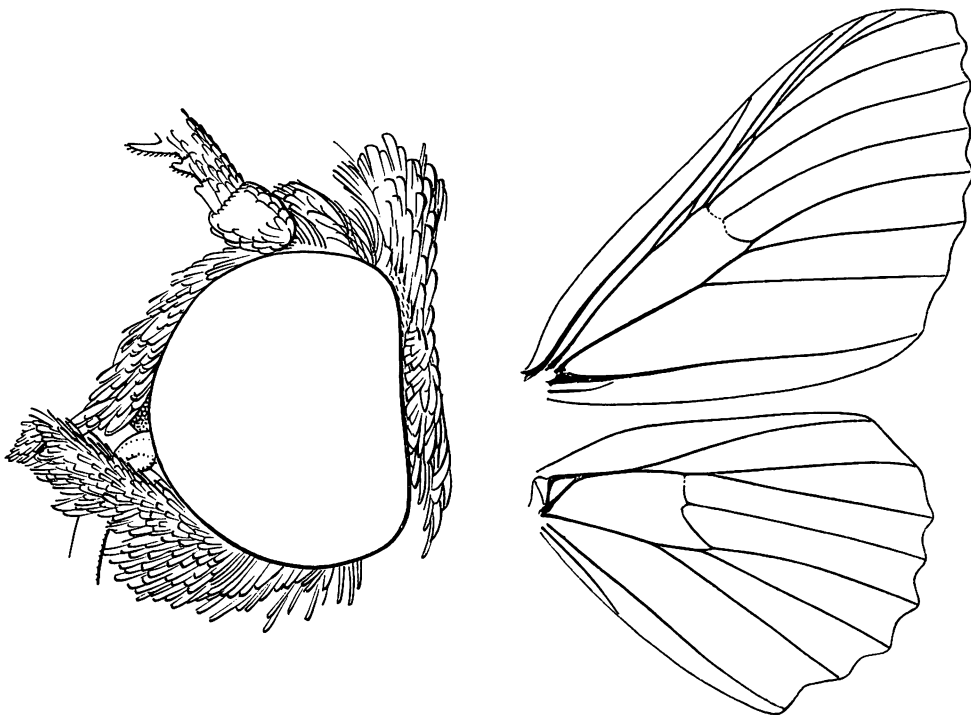


Figure 148—*Progonostola cremnopsis* Meyrick. Head (left) and wing venation (right).

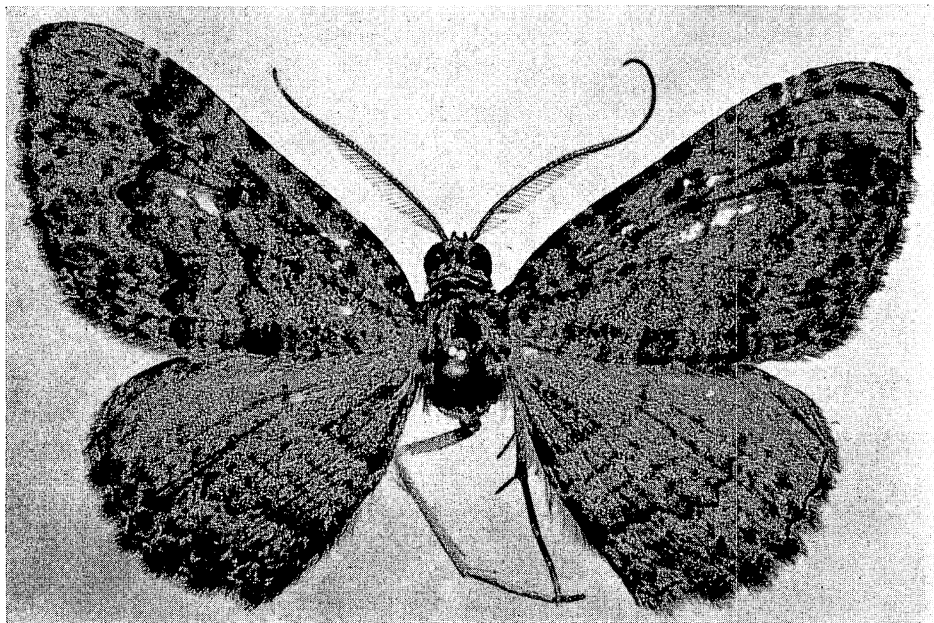


Figure 149—*Progonostola cremnopsis* Meyrick, male type; Molokai Mts., 3,000 feet; expanse, 30 mm. The male has huge anal abdominal tufts.



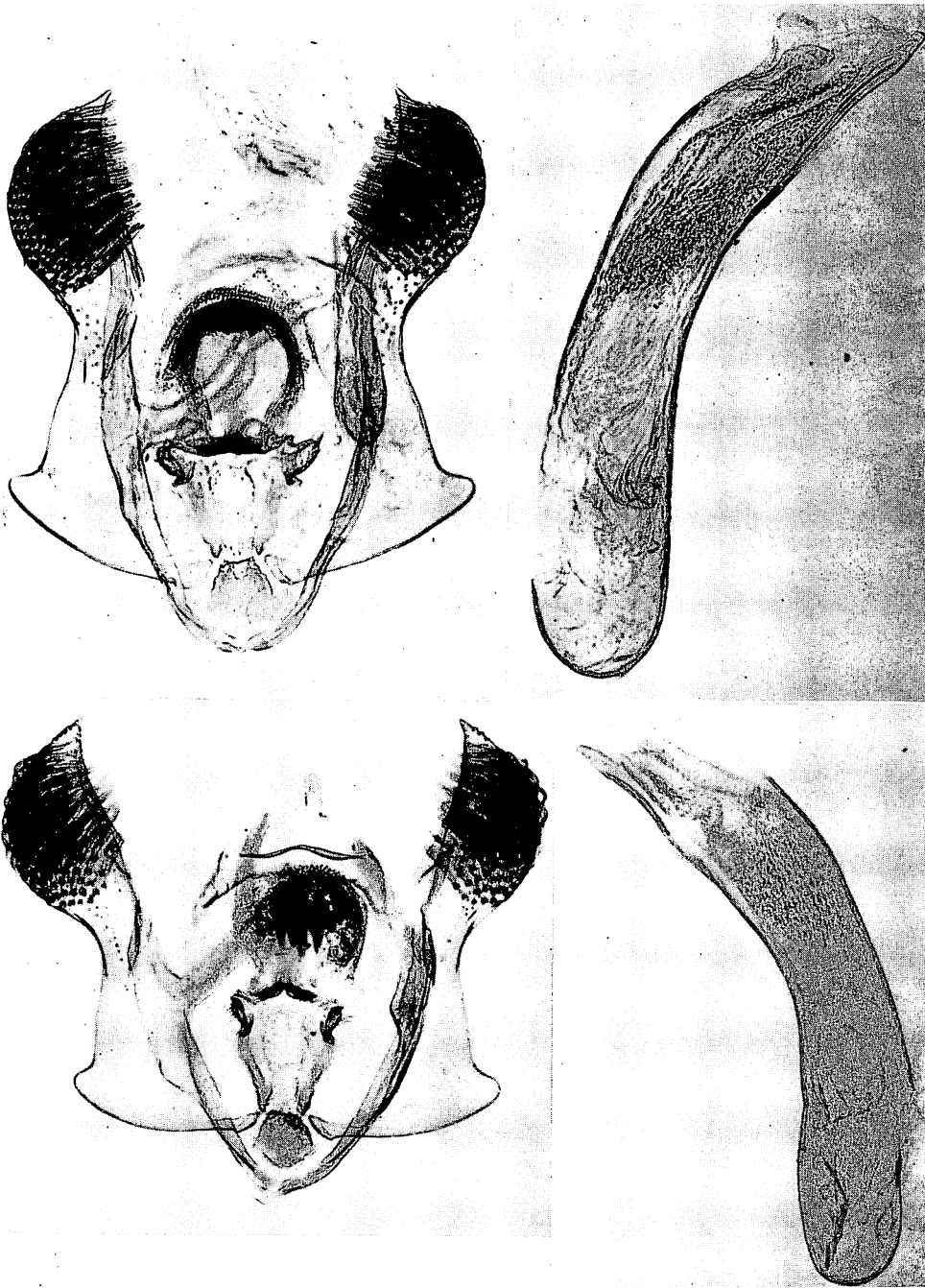


Figure 150—*Progonostola cremnopsis* Meyrick, genitalia of two males. Above: The type from Molokai Mts. Below: A specimen from Oahu.

**Progonostola cremnopsis** Meyrick (figs. 148, 149, 150, 151, 153).

*Progonostola cremnopsis* Meyrick, 1899:167, pl. 4, fig. 25.

Endemic. Kauai, Oahu, Molokai (type locality: 3,000 feet), Hawaii.

Hostplant: Unknown.

This species is most unusual, because the males have unipectinate antennae. The pectinations (see illustration) are hairy all around, and they lack the long, specialized subterminal setae of *Ziela caustoscia*. The antennal segments near the twelfth segment are slightly shorter than their breadths in the male (when viewed from beneath). The third palpal segment is very small and segments two plus three are together only equal to about one-half the diameter of an eye.

Perkins (1913:cl) said: "Near Honolulu it may be found resting on tree-trunks or the stems of tree-ferns on Mt. Tantalus, and on the decomposed lava of steep cliffs at Nuuanu Pali."

Subgenus **ZIELA**, new subgenus

Antennae of male strongly bipectinate, those of female not pectinate but with the longer setae (not the pile) on the under side of the segments long and con-

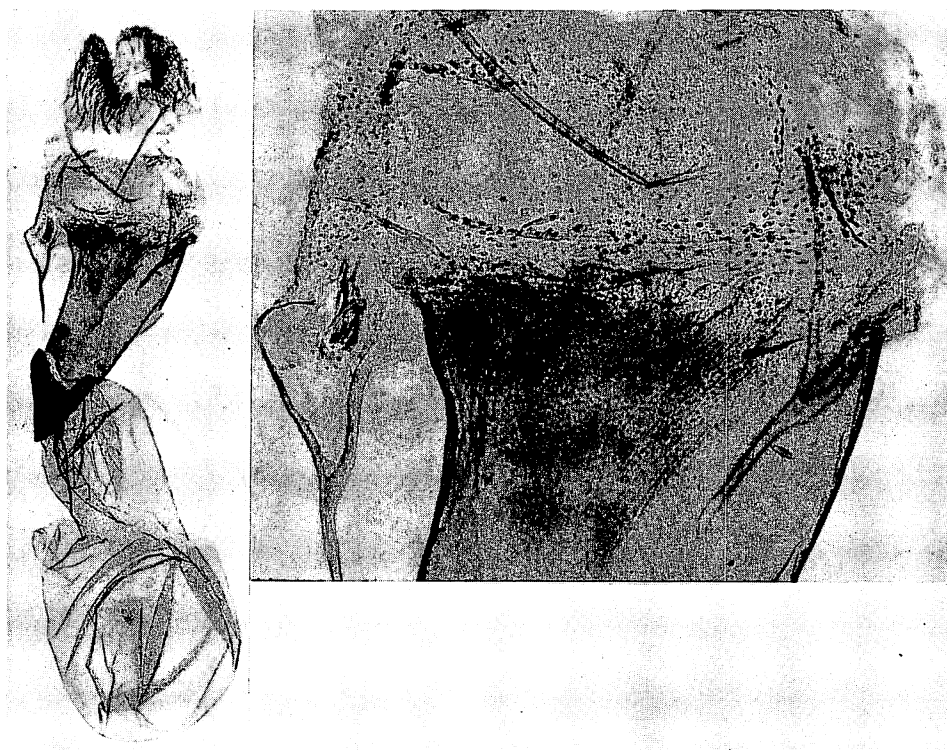


Figure 151—Female genitalia of *Progonostola cremnopsis* Meyrick; Oloo, Hawaii.

spicuous, about as long as the thickness of the shaft in the basal quarter. Head and palpi as illustrated. Scales on anterior half of face whorled into an erect peak. Wings and venation as illustrated; wing margin crenulations well developed. Genitalia as illustrated; in the male the uncus is well developed, the juxta lacks lateral processes, and the valves each have a distal patch of spines.

Type: *Xanthorhoe caustoscia* Meyrick. Gender of *Ziela*: feminine.

It is a difficult problem to decide whether to assign the type to a genus distinct from *Progonostola* or to limit it to subgeneric status. I have chosen the latter course, because I feel that that demonstrates most clearly the relationship of the

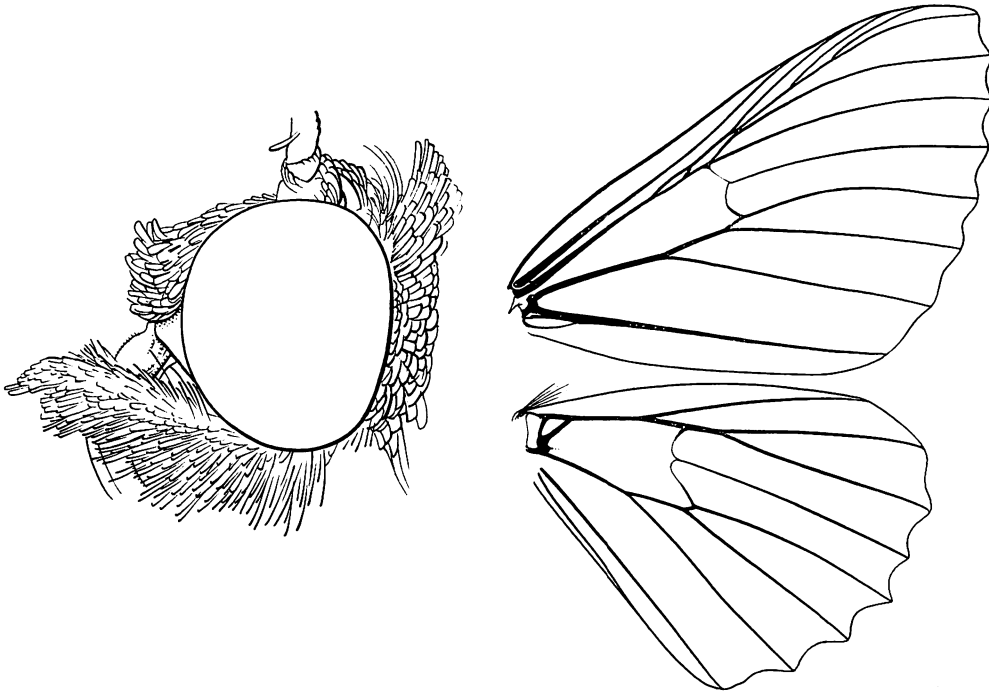


Figure 152—*Progonostola* (*Ziela*) *caustoscia* (Meyrick). Head (left) and wing venation (right).

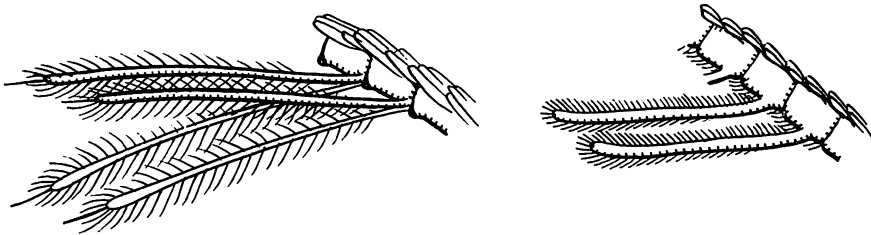


Figure 153—Structure of the antennal segments in *Progonostola* (*Ziela*) *caustoscia* (Meyrick), male type (left), and *Progonostola* (*Progonostola*) *cremnopsis* Meyrick, male type (right).

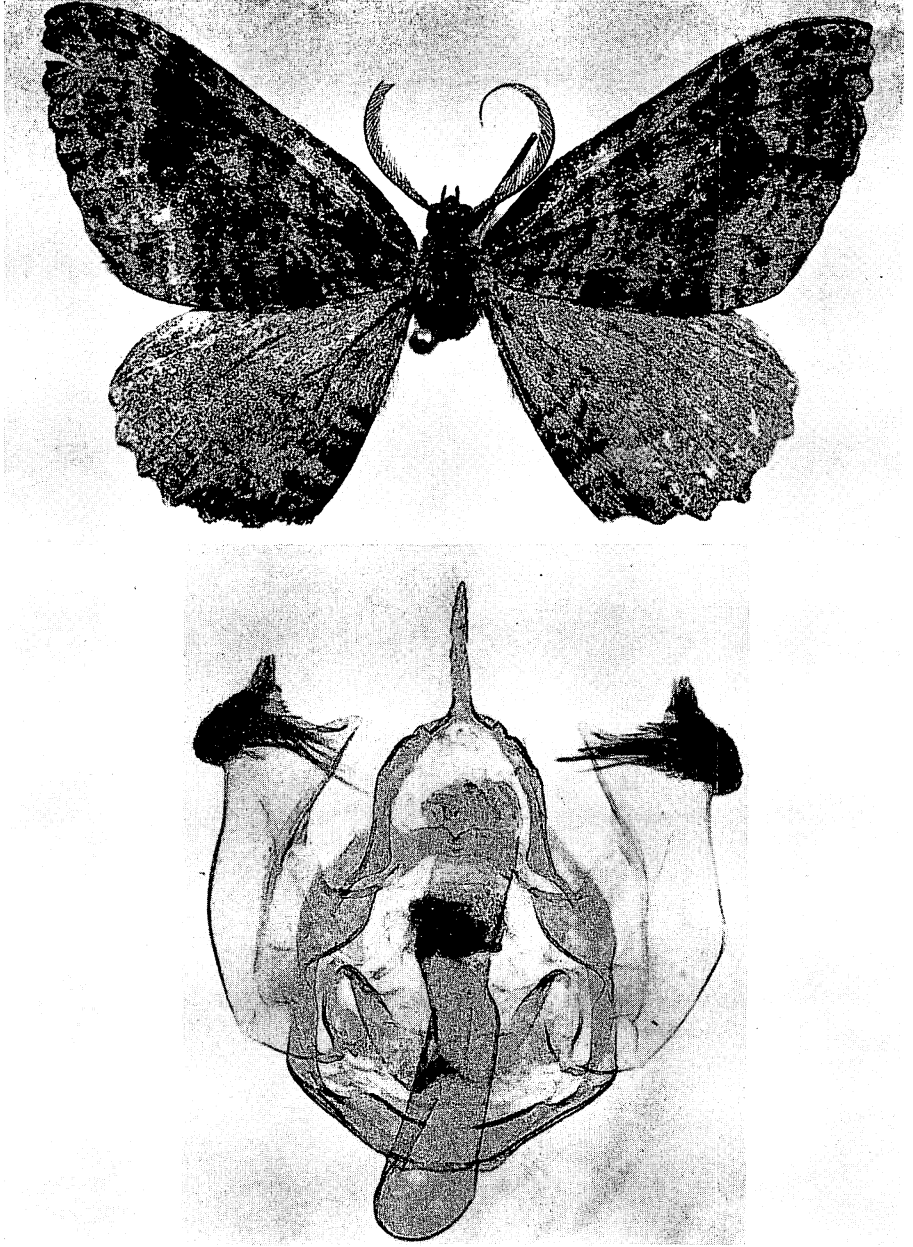


Figure 154—*Progonostola (Ziela) caustoscia* (Meyrick), male type; Haleakala, Maui, 5,000 feet; expanse, 34 mm.; and genitalia.

included species. It is well on its way to generic differentiation, but it has not yet become fully generically distinct. The female, of course, does not display such distinctive characters as the male. The apex of each valve is bifid on this species, whereas it ends in a single point on the type of *Progonostola*. It will be noticed in the illustrations that the sclerotized apical section of the ductus bursae is much narrower in the type species than in any of the other species of this group figured here.

***Progonostola* (Ziela) *caustoscia* (Meyrick), new combination** (figs. 152, 153, 154, 155).

*Xanthorhoe caustoscia* Meyrick, 1899:167. Prout, 1938:258, pl. 25.

Endemic. Maui (type locality: Haleakala, 5,000 feet), Lanai.

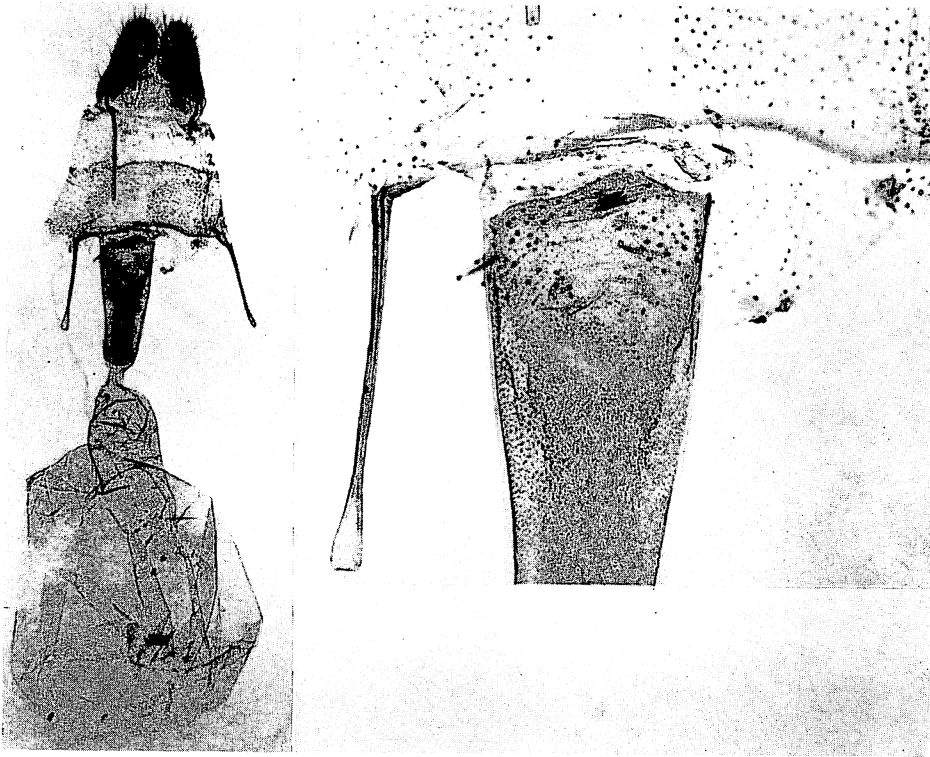


Figure 155—Female genitalia of *Progonostola* (Ziela) *caustoscia* (Meyrick); an example from Lanai.

Hostplant: Unknown.

In color, size and pattern, this species is quite like *Progonostola cremnopsis*, but it is easily separated, in the male at least, by its bipectinate antennae. The palpi are similar to *cremnopsis*, and segments two plus three are less than three-fourths as long as the diameter of an eye. The longer terminal setae on the branches of the male antennae are nearly continuous in course with the long axis of the branches, or they are set at only a small angle from it (see illustration). On the only known species, it will be noticed that the wavy color pattern of the hind wing appears not to extend entirely across the wing as in *cremnopsis*, but it only extends prominently about half way across the wing.

#### Genus **MEGALOTICA**, new genus

This is another endemic genus which belongs in close association with *Progonostola*. It contains only two known, dark, bronzy-brown species with feeble color patterns, and each of these species displays such divergent characters that, as in *Progonostola*, I have decided to split the genus into two subgenera. Here, again, the species are in the process of generic divergence, and it is difficult to decide whether to call the types representatives of subgenera or genera, but I

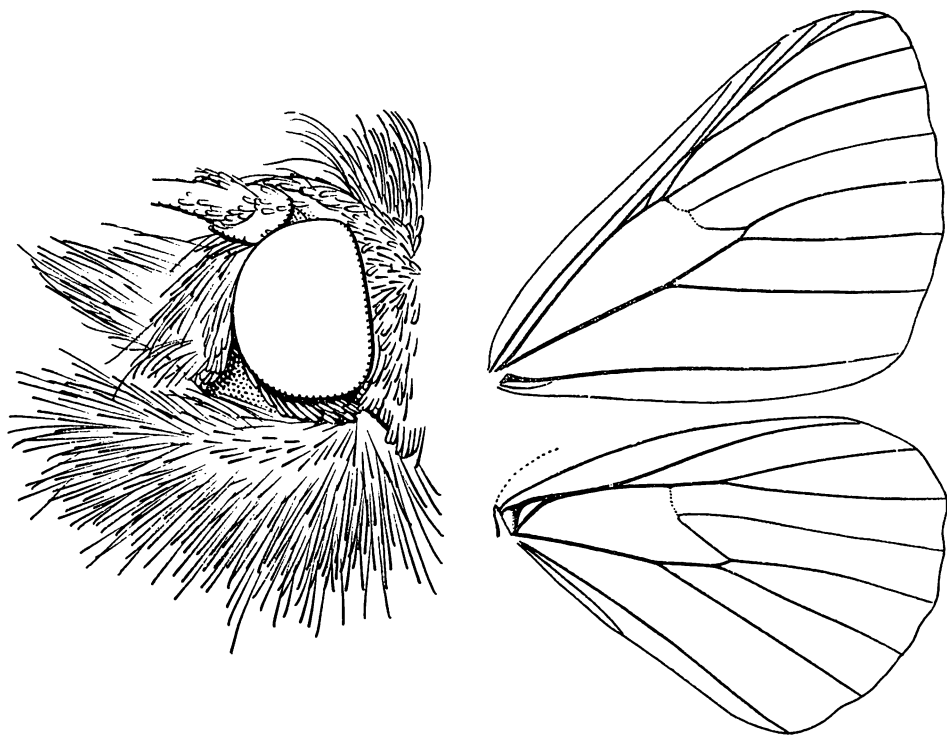


Figure 156—Head (left) and wing venation (right) of *Megalotica holombra* (Meyrick).

believe that they are best kept together in one genus. Attention is drawn to the huge tympana by the generic name which refers to the "big ears"; see the illustrations. An unusual feature, which is particularly striking on *holombra*, is that the wing membrane and veins are fuscous and are thus unlike any of the other Hawaiian geometers.

As noted below, the known species have been observed flying during the day.

Subgenus **MEGALOTICA**, *sensu stricto*

Head and palpi, as illustrated, bristling with long, erect, shaggy hair. Antennae fine and thread-like, but short-furry beneath. Tegulae bristling with long, shaggy, erect hair. Wings and venation as illustrated; marginal crenulation shallow; veins

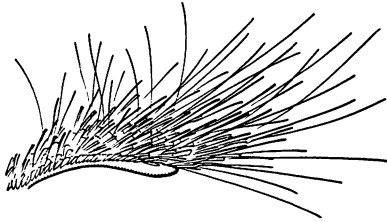


Figure 157—Lateral view of a tegula from the type of *Megalotica holombra* (Meyrick) to show the bristling character of the vestiture.

eight and nine in fore wings forking beyond half way from the areole to apex. Genitalia as illustrated; uncus absent; juxta with a pair of strongly developed processes; valves each with a distal patch of spines.

Type: *Dasyuris holombra* Meyrick. Gender of *Megalotica*: feminine.

***Megalotica holombra* (Meyrick), new combination** (figs. 156, 157, 158, 159).

*Dasyuris holombra* Meyrick, 1899:168, pl. 4, fig. 26.

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Unknown.

This is an unusual species; it is almost entirely brown with a peculiar bronze reflection. The lines on the fore wings are not strongly marked, and the hind wings and under surfaces of the wings are concolorous. The shaggy vestiture of the head, palpi and tegulae is unique in the family in Hawaii. Palpal segments two plus three are one-fourth longer than the diameter of an eye. The gena is broad and squamose. The rough hair on the front of the head is drawn out into a rough peak. The antenna on the male holotype, viewed from the side, has the segments near the twelfth segment about two-sevenths longer than broad, and the segments are short-furry beneath. The tympanum is a very large and noteworthy organ, and it is strange that it was not mentioned by Meyrick. The subapical abdominal hair-tufts of the male are very large.

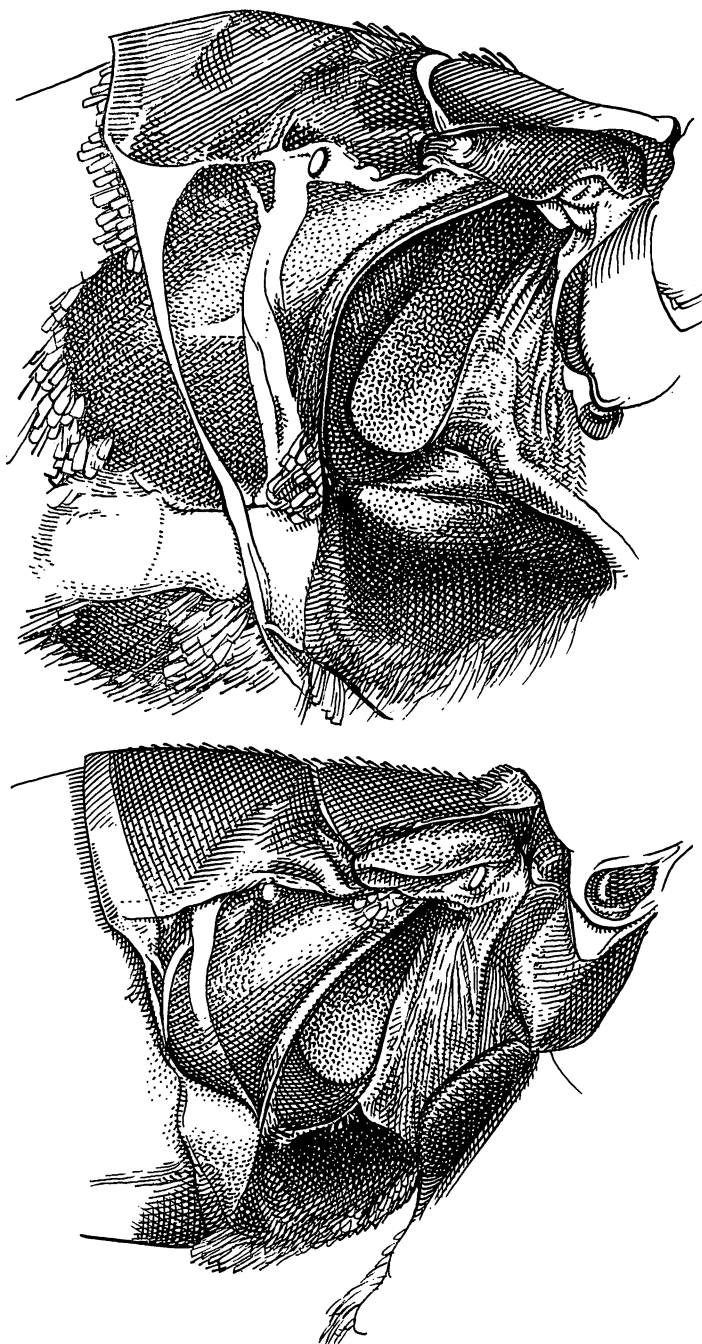


Figure 158—Basal parts of denuded abdomens of *Megalotica holombra* (Meyrick) (above), and of *Megalotica (Gela) aphoristis* (Meyrick) (below), to show the large tympana and surrounding areas. Note the spiracle and associated shallowly subcutaneous trachea on *holombra* and compare *aphoristis*. Compare these figures with figure 116 of *Eupithecia monticolans* Butler.



Perkins (1913:xxxix) said: "... the conspicuous dark-coloured, day-flying moth, *Dasyuris holombra*, of which two specimens are recorded, I observed in hundreds, if not thousands on one occasion, flying in the forest on Maui, but being always hampered with a gun and much occupied with birds, I neglected to catch a series and did not again have the chance." It is most unfortunate that Perkins did not

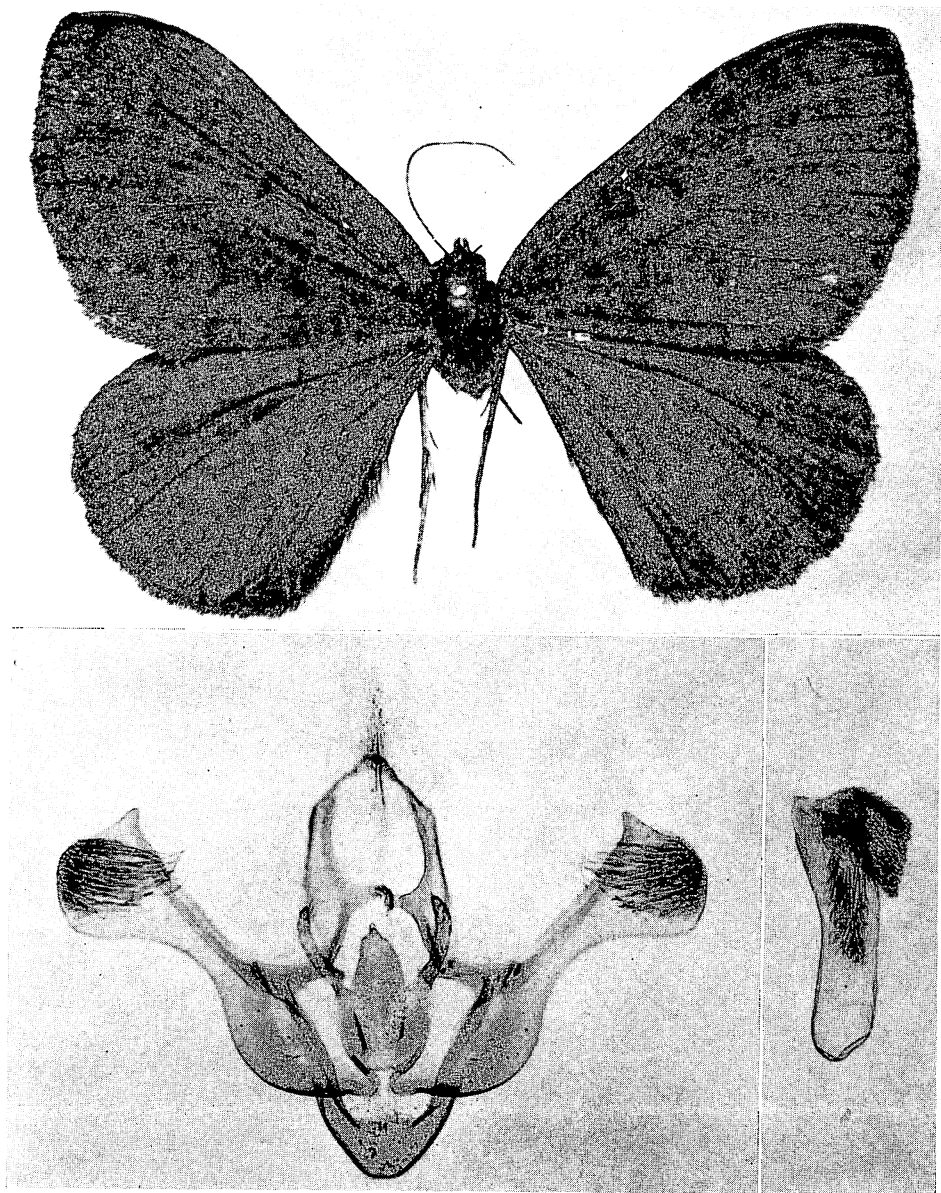


Figure 159—*Megalotica holombra* (Meyrick), male type; Haleakala, Maui, 3,000 feet; expanse, 33 mm.; and genitalia. There is no uncus, but the anal tube membrane, and some debris in the tube, show in the photograph and may appear to indicate an uncus where there is none.

capture a series of this interesting and unusual insect, because only a few specimens have been seen since, and I do not know the female.

Subgenus **GELA**, new subgenus

The type of this subgenus resembles a small *Megalotica* (*Megalotica*) *holombra* with bolder markings. Head and palpi as illustrated, scaled instead of bristling with much erect hair. Tegulae with mostly scales and comparatively few long hairs, and hairs mostly horizontal and not erect. Wings and venation as illustrated; marginal crenulation moderate; in fore wing, veins 8 and 9 fork basad of middle of the distance between the areole and the apex. Genitalia as illustrated; uncus small, but distinct; juxta with a pair of long, strongly developed processes; each valve with a distal tuft of spines.

Type: *Hydriomena aphoristis* Meyrick. Gender of *Gela*: feminine.

The type has the apex of each genital valve bifid, whereas it has a single point on the type of the subgenus *Megalotica*. Thus, the development of the male genitalia in each of the subgenera of *Megalotica* is of the same character as that in the two subgenera of *Progonostola*. The loss of the uncus in *Megalotica* and *Progonostola* is noteworthy.

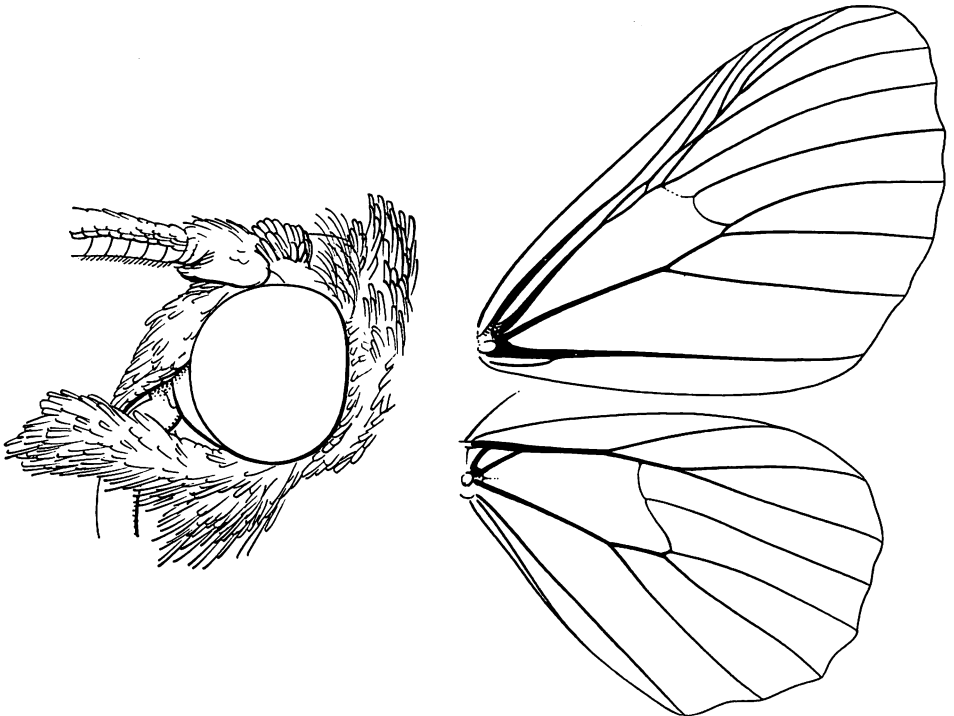


Figure 160—Head (left) and wing venation (right) of *Megalotica* (*Gela*) *aphoristis* (Meyrick).

**Megalotica (Gela) aphoristis** (Meyrick), **new combination** (figs. 158, 160, 161, 162).

*Hydriomena aphoristis* Meyrick, 1899:165, pl. 4, fig. 22.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

This is much like a diminutive *Megalotica holombra*. It has the same type of bronzy-brown coloration which in Hawaii is shared only with *holombra*. The

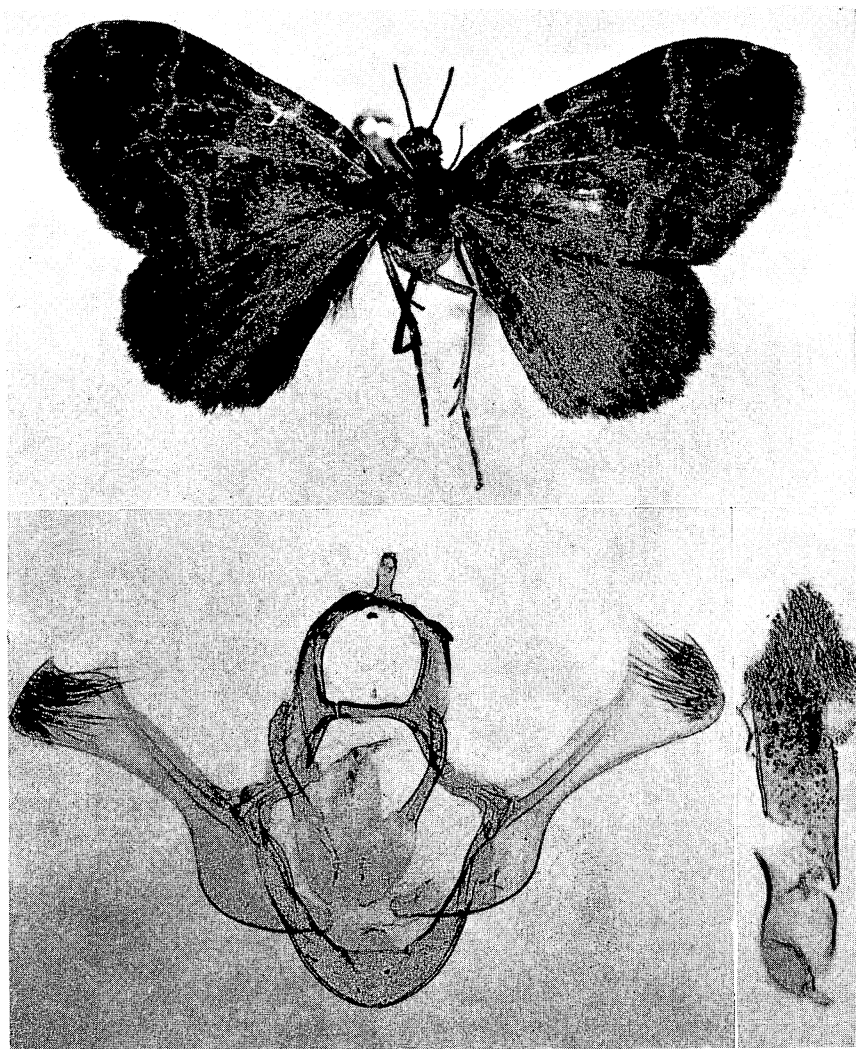


Figure 161—*Megalotica (Gela) aphoristis* (Meyrick), male type; Kilauea, Hawaii; expanse, 20.5 mm.; and genitalia.

genitalia show that this is obviously allied to *holombra*, and if it were not for the very different vestiture and presence of the uncus (absent in *holombra*), I would place it in the typical subgenus. The scales on the front of the head protrude well forward in a pointed projection over the base of the proboscis, but the cluster is not elevated or erected. The male antennal segments are short-furry beneath, and the scaling is several scales wide on the dorsal sides of the segments. On the male holotype, the segments in the vicinity of the twelfth segment are slightly broader than long. Palpal segments two plus three are subequal in length to the diameter of an eye. The gena is bare (squamosa in *holombra*). The tympanum is very large.

Perkins (1913:cl) noted that this species was also seen flying during the day and has habits rather similar to those of *Megalotica holombra*, but we know nothing more about it.

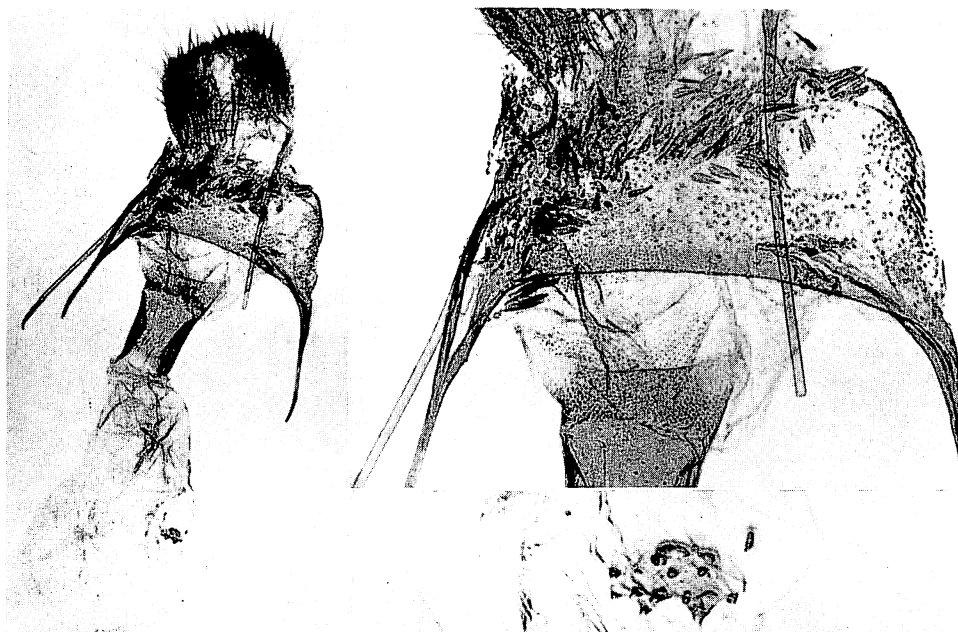


Figure 162—Female genitalia of *Megalotica (Gela) aphoristis* (Meyrick); Kula Pipe Line Trail, Maui. Enlarged view of signum at lower right.

## Superfamily NOCTUOIDEA

*Noctuae* Linnaeus, 1758:496, 508.

*Phalenites* Latreille, 1803:323, in part.

*Bombicines* Latreille, 1805:142, in part.

*Noctuoidea* Mosher, 1916:33, 107.

## Family NOCTUIDAE

*Noctuaelitae*, *Noctualites* Latreille, 1809:191, 224. Guenée, 1852:1.

*Noctuides* Leach, 1815:133.

*Noctuadae* Samouelle, 1819:250.

*Noctuidae* Stephens, 1829:100. Herrich-Schaeffer, 1850:327.

*Noctuae* Boisduval, 1840:89.

*Agrotides* Rambur, 1848:67.

*Agrotidae* Heinemann, 1859:488. Grote, 1895:43. Tams, 1935:170.

*Phalaenidae* Barnes and Benjamin, 1923:55 (not of Latreille, 1803, Leach, 1815, Samouelle, 1819, or Boisduval, 1833, really Geometridae).

For discussion of family name, see Barnes and Benjamin, 1923:55, Tams, 1935:170, and Franclemont, 1952:307–309, 311. For monograph of family, see Hampson's "Catalogue." For classification based on pupae, see Mosher, 1916. Also, see Hampson, various dates; Forbes, 1934; McDunnough, 1929; Smith, 1882.

This is the largest family of Macrolepidoptera in Hawaii, and endemic species have been produced in the following 11 genera: *Agrotis*, *Peridroma*, *Pseudaletia*, *Haliophyle*, *Plusia*, *Gonitis*, *Anomis*, *Hypocala*, *Hypena*, *Schrankia* and *Pseudoschrankia*. Of these genera, *Haliophyle* and *Pseudoschrankia* are, as far as we know now, endemic. All of the other genera are widespread, and *Agrotis*, *Peridroma*, *Pseudaletia*, *Plusia*, *Anomis*, *Hypena* and *Schrankia* are well developed in the Holarctic, and many of these also invade the warmer parts of the world and the southern hemisphere.

As in most groups of Lepidoptera, the classification of this family rests in a state of great confusion, and few authors appear to hold similar views regarding the supra-generic taxonomy. Tietz, 1937:61, said: . . . "Probably no group of insects needs a more careful revision than the Noctuidae (Phalaenidae). Such a task is not easy because so many species are involved. Many have tried to group these species into genera but few workers agree upon what constitutes a genus. This lack of harmony has led to confusion. Many specialists will accept a genus even though they may not be able to define it. Most of the recently erected genera have been well described and defined but the older ones need to be redescribed and their boundaries more clearly set."

Scores of subfamily names exist in literature on the Noctuidae, but most of them are incorrectly used. A number of the valid older names have been dropped wrongly from use. The existing confusion is extraordinary. I have concluded,

after spending much time (perhaps I should say wasting time) on the problem, that it is impossible to present in this text a correct suprageneric classification. It remains for some widely experienced author to make a complete survey of the literature from Linnaeus onward, to examine critically all names used (and many of these first appeared in works now uncommon and found in few libraries), to establish detailed and correct synonymy, to redefine carefully the suprageneric groups and to lay a new foundation for them. It will not be easy to accomplish this work, and a long period of research will be required. Obviously, such a task is beyond the scope of *Insects of Hawaii*.

For an historical sketch of the classification of the Noctuidae, and an interesting biographical account of the workers before 1852, see Guenée, 1852:XL-XC.


The basic work on the family is the enormous 16 volume *Catalogue of the Lepidoptera Phalaenae in the British Museum* by Sir George Hampson. Few persons in the history of biology have ever succeeded in publishing such an extraordinary work. The series of books is a monument of individual productivity and great perseverance. The first volume was published in 1898, and Volume 13 appeared in 1913—a remarkably short interval for such a detailed monograph. A supplement was published in 1914, another in 1920, and Tams supervised the preparation and publication of a posthumous supplement in 1926. The work contains hundreds of black and white figures and hundreds of colored illustrations. Unfortunately, Hampson did not live to complete his great work, and there remains in the British Museum a mass of his unpublished manuscript which includes the revisions of a number of the noctuid groups which are not treated in the encyclopedia. There is, then, no guide to some of the subfamilies.

The usefulness of Hampson's work is diminished somewhat because of his idiosyncrasies, and had he only adopted a more fortunate course, all subsequent workers would have been spared much labor and confusion. I have found it impossible to fit all of our species into the Hampson system, either as it was published or as it was somewhat modified by him as he worked over and arranged the collections in the British Museum. Some species of some of our genera may fit into one subfamily, but other species of the same genera cannot be placed in the same subfamily according to Hampson's arrangement and characterizations. I have decided, therefore, to simplify matters by presenting here a general key to all of the genera of our Noctuidae and to omit a key to subfamilies.

I have found that many of the drawings in Hampson's work are faked or are reconstructions. He frequently presented perfect illustrations, whereas the only example available to him was a damaged specimen. He has reconstructed wing veins without noting the fact. It is difficult to interpret wing venation without proper bleaching and cleaning, yet he published complete drawings of specimens which were not cleaned. Of course, Hampson is not alone in this procedure which often leads to error.

See Mosher, 1916, for classification based upon pupae, and key to subfamilies on p. 108.

## KEY TO THE GENERA OF NOCTUIDAE FOUND IN HAWAII

1. Vein five in hind wing thin or obsolescent, obviously not developed as four or six, originating from or just behind middle of discocellulars. . . . . 2  
 Vein five in hind wing well developed, similar or rather similar in development to veins four or six, originating from near middle or well behind middle of discocellulars. . . . . 11
- 2(1). Hind tibiae spined along sides. . . . . 3  
 Hind tibiae not spined along sides. . . . . 5
- 3(2). Fore tibiae, excluding terminal pair of spines, usually with only two or three spines on inner edge, without spines on outer edge. . . . . **Heliothis.**  
 Fore tibiae, excluding terminal pair of spines, with many spines on inner edge, outer edge with or without similar spines. . . . . 4
- 4(3). Fore tibiae with numerous spines on outer edge. . . **Agrotis.**  
 Fore tibiae without spines on outer edge (excluding apical spur). . . . . **Peridroma.**
- 5(2).  Eyes clothed with long, conspicuous, erect hairs (view eyes in profile for best view of hairs). . . . . 6  
 Eyes not hirsute. . . . . 8
- 6(5). First segment of fore tarsus with a series of long, stout, arcuate, very conspicuous spines along outer edge, the apical one especially prominent, broad and rather blade-like; tarsal claws not toothed; frons in our species protuberant behind middle, and with a broad, deep, very prominent, transverse concavity from middle to apical margin which is prominently and narrowly elevated as a rim above the gutter-like concavity (scales may have to be removed to see these characters); vestiture of tegulae mostly scale-like, broad-tipped and multidentate in our species. . . . . **Trichoclea.**  
 Fore tarsi without such spines; tarsal claws toothed beneath; frons without a transverse concavity; anterior margin at most slightly elevated; vestiture of tegulae mostly hair-like, never broad-tipped. . . . . 7
- 7(6). Hairs of tegulae mostly distinctly bidentate at apices (our species have the transverse lines in fore wings obsolete or represented by dots). . . . . **Pseudaletia.**  
 Hairs of tegulae mostly simple at apices (transverse lines on fore wings developed and usually conspicuous). . . . . **Haliophyle.**

- 8(5). Proboscis very much reduced, obsolescent . . . . . **Acrapex**.  
 Proboscis fully developed . . . . . 9
- 9(8). [The following three genera, although, judged by the  
 genitalia, they are not at all closely related, are ex-  
 tremely alike in external characters of generic value  
 and are most difficult to separate because of the lack  
 of good external differences:]  
 Second palpal segment about three times as long as  
 broad; greatest diameter of an eye subequal to length  
 of second palpal segment only . . . . . **Elaphria**.  
 Second palpal segment only about twice as long as  
 broad; greatest diameter of an eye subequal to length  
 of second and third palpal segments combined . . . . . 10
- 10(9). Fore wings only about twice as long as broad, more or  
 less subparallel sided beyond basal fourth; greatest  
 distance between vein 1b and hind margin fully as  
 great as greatest breadth of cell . . . . . **Elydna**.  
 Fore wings distinctly more than twice as long as  
 broad, rather narrowly wedge-shaped; greatest dis-  
 tance between vein 1b and hind margin only about  
 one-half breadth of widest part of cell . . . . **Spodoptera**.
- 11(1). Vein five of hind wing parallel or subparallel to four . . . 12  
 Vein five in hind wing not parallel to four, obviously  
 nearer vein four basad than distad . . . . . 18
- 12(11). Palpi upturned or vertical . . . . . 13  
 Palpi porrect . . . . . 16
- 13(12). Termen angulately produced at middle . . . . . 14  
 Termen arcuate, not angulate . . . . . 15
- 14(13). Crown of head clothed with erect hair . . . . . **Gonitis**.  
 Crown of head clothed with prostrate, or subprostrate,  
 imbricated, broad scales . . . . . **Anomis**.
- 15(13). Cell in hind wing extending to middle of wing; antennae  
 of male setose but not pectinate . . . . . **Amyna**.  
 Cell in hind wing short, extending only to basal third of  
 wing; antennae of male very strongly bipectinate . .  
 . . . . . **Bocana**.
- 16(12). Fore wings with areole present, veins nine and ten  
 separate, nine thus having only one fork . . . . **Hypena**.  
 Fore wings with areole absent, veins eight, nine and ten  
 fused for some distance from cell, vein nine thus ap-  
 pearing to have two forks and three terminal branches . . 17
- 17(16). Palpi less than four times and usually less than three  
 times as long as diameter of an eye; antennae of male  
 with numerous, fine, simple hairs beneath; ocelli ob-  
 solete . . . . . **Schrankia**.



- Palpi more than four times as long as diameter of an eye; antennae of male strongly bipectinate, the pectinations long and these in turn conspicuously hairy beneath; ocelli present. . . . . **Pseudoschrankia**.
- 18(11). Fore wings with one or more small patches of raised scales on upper side near apex of cell. . . . . **Stictoptera**.  
Fore wings without raised patches of scales. . . . . 19
- 19(18). Middle tibiae with conspicuous longitudinal rows of spines. . . . . **Achaea**.  
Middle tibiae not spined. . . . . 20
- 20(19). Head with a cluster of long hairs or bristles just in front of insertions of antennae which are differentiated from the other vestiture of head at that point and which usually project partly over eyes and more or less vaguely suggest lashes; our species with specialized white or pale submetallic patches near middle of fore wing (Plusiinae). . . . . 21  
Head without such specialized bristles and fore wings without such markings. . . . . 23
- 21(20). Antennae bipectinate in both sexes. **Plusia (Lophoplusia)**.  
Antennae not bipectinate in either sex. . . . . 22
- 22(21). Posterior tarsus of male with a conspicuous row of many (about 15) long spines on inner surface of about basal half of first segment which project inward at nearly right angles to tarsus and resemble teeth of a comb (these spines are in addition to the usual ventral rows of tarsal spines); female with an extraordinary, long, tape-like ductus bursae. . . . . **Plusia (Trichoplusia)**.  
Posterior tarsus of male without any accessory comb of spines; female ductus bursae not long and tape-like. . . . . **Plusia (Autographa)**.
- 23(20). Very large species, expanse over 100 mm. . . . . **Otosema**.  
Much smaller species, expanse less than 60 mm. . . . . 24
- 24(23). Termen of fore wing conspicuously irregular and angularly produced outward at middle, as in figures 320–324. . . . . 25  
Termen of fore wing convexly arcuate. . . . . 26
- 25(24). Crown of head clothed with erect hair. . . . . **Gonitis**.  
Crown of head clothed with broad, prostrate or subprostrate, imbricated scales. . . . . **Anomis**.
- 26(24). Fore wing without an areole, veins nine and ten fused basally so that ten appears to arise as a stalk of nine (thus nine appears to have two branches). . . . . **Simplicia**.  
Fore wings with areole present, vein ten arising from cell and free from nine (nine thus has only one branch). . 27

- 27(26). Palpi angulate, terminal segment directed forward, or forward and downward at a distinct angle from second segment and at most hardly longer than greatest breadth of second segment. . . . . **Hypocala.**  
 Palpi not so formed, terminal segment directed upward continuously with penultimate segment. . . . . 28
- 28(27). Palpi moderate in length, apex not rising much above top of head, terminal segment shorter than diameter of an eye, as illustrated; antennae of male not bipectinate. . . . . **Polydesma.**  
 Palpi long, apex rising far above top of head, terminal segment long and slender, longer than diameter of an eye, as illustrated; antennae of male strongly bipectinate. . . . . **Bocana.**

#### KEY TO THE LARVAE OF SOME SPECIES OF NOCTUIDAE WHICH ATTACK PLANTS IN GARDENS

It is unfortunate that so few detailed morphological data are available regarding the caterpillars of the Hawaiian Noctuidae, and it remains for future workers to supply detailed accounts. Dr. Swezey, however, has assembled notes on many of the species of economic importance, and he prepared (1944:141) a key to a few species which are commonly found in gardens. I have altered and adapted his key for this text. Some of our species are included in Crumb's new bulletin, *The Larvae of the Phalaenidae*, 1956.

1. Prolegs present only on abdominal segments five and six, thus only two pairs present. . . . . 2  
 Four pairs of prolegs present, and these on abdominal segments three, four, five and six. . . . . 3
- 2(1). Sides of body with a conspicuous white line just above spiracles, and this line occupying most of the space between each spiracle and the first seta (seta "III" as used by Swezey) above the spiracle; length 30 to 40 mm.; on many kinds of plants. . . . . **Plusia chalcites** (Esper).  
 The described white line occupying only one-third to one-half the space described; length 25 to 30 mm.; on cabbage and other crucifers, occasionally on lettuce. . . . . **Plusia (Trichoplusia) ni brassicae** (Riley).
- 3(1). Metathorax and first four abdominal tergites each with a yellowish discal spot. . . . .  
 . . . . **Peridroma porphyrea** (Denis and Schiffermueller).  
 Dorsum without such spots. . . . . 4

- 4(3). Derm either minutely spinulose or granulose or with numerous minute sclerotized platelets. . . . . 5  
 Derm without such structures. . . . . 6
- 5(4). Derm with numerous minute spines. . . . . **Heliothis**.  
 Derm granulose or with numerous, irregular, minute, sclerotized platelets. . . . . **Agrotis ipsilon** (Hufnagel).
- 6(4). Derm of dorsum with numerous, irregular, small white spots and more or less vermiculate lines, and with darker longitudinal stripes. . . . . 7  
 Without such markings. . . . . 9
- 7(6). Tergites, except pronotum, each with a pale medial band flanked on either side by a darker band consisting of subvermiculate markings, and at the outer edge of each of these bands is a prominent dark streak which is not as long as the tergite, thence there is another pale band similar to the middorsal line, and this in turn is flanked by a band of subvermiculate markings above the spiracles; the dark dashes form two broken lines down the back of the caterpillar and are the most conspicuous markings. . . . .  
 . . . . . **Spodoptera mauritia acronyctoides** (Guenée).  
 Not so. . . . . 8
- 8(7). Spiracles black; dorsum with two longitudinal dark stripes separated by a narrower pale longitudinal stripe. . . . .  
 . . . . . **Spodoptera exempta** (Walker).  
 Spiracles pale with black rims; pale area on dorsum with a narrow, medial, darker stripe enclosing a broken, middorsal pale line. . . . . **Spodoptera exigua** (Huebner).
- 9(6). Head pale testaceous with brown reticulation; the broad dorsal pale area of body mottled with pale brown and fuscous; the black spiracles set at the lower margin of a longitudinal dark body stripe which is somewhat segmentally interrupted. . . . .  
 . . . . . **Pseudaletia unipuncta** (Haworth).  
 Head dark brown in front, paler above and on sides; body dark and appearing velvety; abdominal segments six and seven with two dorso-lateral darker spots. . . . . **Elydna nonagrica** (Walker).

## Subfamily NOCTUINAE

*Noctuida* Leach, 1815:134.

*Noctuelidi* Boisduval, 1829:63.

*Heliothidi* Boisduval, 1829:94.

*Heliothes* Boisduval, 1833:95.

*Heliothides* Boisduval, 1840:161.

*Heliothidae* Guenée, 1852:166.

*Agrotinae* Mosher, 1916:109. Hampson, 1918:383.

*Phalaeninae*, of some authors.

Mosher, 1916, gives a key to some genera based upon the pupae.

Genus **HELIOTHIS**

*Heliothis* (Huebner, *Tentamen*, 1806:2) Ochsenheimer, 1816:91; type *Phalaena Noctua dipsacea* Linnaeus, cited by Thon, in Ersch and Gruber, *Allgemeine Encyclopädie der Wissenschaften* (2)5:131, 1829 (not checked).

*Chloridea* Westwood, 1841. Tams, 1935:196. Heinrich, 1939:595.

Part of the original manuscript for this section was assembled in a report on the genus for the Hawaiian Entomological Society (see Zimmerman and Fletcher, 1956), and some of the information used there is repeated here. When this manu-

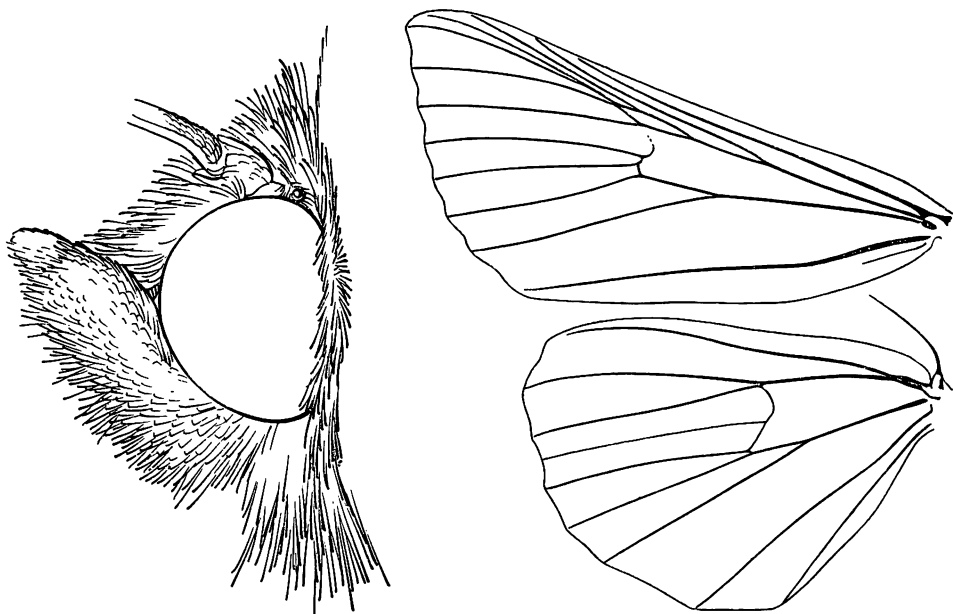


Figure 163—*Heliothis harwaiiensis* (Quaintance and Brues). Head and wing venation.

script was nearly ready to be sent to the editor, a specimen of a newly established third species was sent to me for identification, and it is now incorporated.

References to *Heliothis armigera* (Huebner), the corn earworm, or supposed synonyms, have long appeared in Hawaiian literature. In 1880, Butler first listed the species from Hawaii as *Heliothis conferta* Walker, from specimens collected by Blackburn ("Bred from larvae found very rarely in company with that of *Vanessa Huntera*, on flowers of a species of 'everlasting' on Maui." Butler, 1880:8). Although the species was long known as a notorious pest of corn and cotton in America, it was not reported as a pest of these crops in Hawaii. In 1922 (*Proc. Hawaiian Ent. Soc.* 5 (2):185, 1923) Swezey reported that "The caterpillars of this moth are known as the cotton boll worm and corn ear worm in the Southern States, but in Hawaii they have not been recorded as injurious to those plants." However, by forced feeding in the laboratory, Swezey found that the caterpillars fed "voraciously" upon green sweet corn, and he stated that "It is not understood why corn in the field has not been reported attacked by these caterpillars." In 1930 corn was apparently suddenly attacked in Hawaiian fields, and since then corn earworms have been major pests of corn in Hawaii, and chemicals have had to be used to control them. In February, 1930, (*Proc. Hawaiian Ent. Soc.* 7 (3):369, 1931) Swezey reported finding larvae in corn, and, it was reported that "This is the first time that he had found larvae of this species attacking corn. . . ." In November, 1930, Ehrhorn (*Proc. Hawaiian Ent. Soc.* 7(3):389, 1931) reported upon the prevalence of the caterpillars on corn, and it was stated that "it had hardly been known as a corn pest here heretofore." Within the next few years, infestation became general, and at times hardly an ear of corn could be found uninfested.

This apparently unusual behavior raised the question of whether the records for the moth in Hawaii were based upon correct identifications or whether the moth had suddenly changed its habits. Investigations did not reveal any apparent differences of specific nature between specimens collected long before 1930 and those found damaging corn after 1930, and the differences that were observed were considered to be only individual variations in a species well known for its extreme variability. It was also considered that there might be two strains present in Hawaii: one, an early immigrant which was a non-corn-eating strain, and the other, introduced about 1930, a corn-eating strain.

In 1956, Zimmerman and Fletcher reported that a careful re-examination of Hawaiian specimens, in the light of more experience with comparative studies of genitalia and stimulated by the work of recent authors, revealed that not only is *Heliothis armigera* not present in Hawaii, but that two other species have been confused under that name in Hawaii. One of these species, *hawaiiensis* (Quaintance and Brues), has long been in Hawaii, and it was named three different times, but the names escaped the notice of Hawaiian entomologists. The second species, which evidently became established in Hawaii shortly before 1930, is *Heliothis zea* (Boddie), described from the United States in an obscure journal rarely used for entomological reports, and the name *zea* also escaped general notice until Todd (1955:600) rescued the name from obscurity. These discoveries

place the apparent anomalous habits of the moths in Hawaii in a different light, and, of course, solve the hostplant problem.

*Heliothis* is a complex containing many forms of similar facies which are often difficult to separate by external characters. Some species, however, are distinctive and easily identified. The newly established *virescens* is easily identified, but the other two species, and others apparently allied to them or resembling them superficially, seem most easily and reliably distinguished by characters of the aedeagus. Fletcher and I were unable to discover useful characters in the genitalia of the females to distinguish *hawaiiensis* from *zea*. The genital valves of those species evidently differ only in degree instead of in major structure or shape.

As noted above, *virescens* is easily determined, but *hawaiiensis* and *zea* may be difficult to determine. Although the following key will facilitate the identification of the latter two species, it must be borne in mind that the color pattern is subject to much variation. Not all examples of either *hawaiiensis* or *zea* have the color pattern as described in the key, and specimens of either species may overlap in some of the color pattern characters, but the species can be determined by using a combination of the characters.

#### KEY TO THE SPECIES OF *HELIOTHIS* IN HAWAII

1. Upper side of fore wing with three diagonal pale bands, each outwardly dark-edged, running from costa to posterior margin . . . . . ***virescens*** (Fabricius).  
Fore wing without such diagonal bands . . . . . 2
2. Upper side of hind wing with the dark terminal band interrupted by a usually prominent pale patch at about middle, as illustrated; lower side of hind wing with the dark terminal band obsolescent and usually with only a dark spot at apex of vein 2, as illustrated; aedeagus without a sub-apical thorn-like tooth, and with two clusters of long, mostly individually well-defined cornuti, as in figure 164 . . . . . ***zea*** (Boddie).  
Upper side of hind wing with the broad, dark, terminal band usually entire and without a prominent pale patch, as illustrated; lower side of hind wing with the terminal dark band usually much more extensive than in *zea* and usually more as in figure 164; aedeagus with a well-defined, sub-apical, thorn-like tooth, directed basad, and with a long, continuous band of more numerous, smaller, more slender cornuti, as illustrated . . ***hawaiiensis*** (Quaintance and Brues).

Because of the former confusion of *hawaiiensis* and *zea*, the hostplant records in Hawaii must be revised, because it is impossible to tell from many of the records after about 1930 which of the two species was involved. I have assembled the following hostplant records which apply to one or the other or both of these species:

African daisy, *Ageratum*, amaranth, cabbage, carnation, carrot, Chinese pea, *Cicer arietinum* (chick pea or garbanzo), corn, cotton, cowpea, *Cyphomandra betacea* (tree tomato), eggplant, a species of "everlasting" (*Gnaphalium*), *Euxolus*, garden bean, gladiolus, *Gossypium tomentosum*, *Heterotheca grandiflora*, *Hibiscus*, Italian gourd, Italian squash, lettuce, lima bean, *Malva*, *Malvastrum*, marigold, *Myoporum sandwicensis*, papaya, green pepper, potato, rose, *Sida cordifolia*, *Siegesbeckia*, snapdragon, Sudan grass, tomato, watermelon.

The parasites *Eucelatoria armigera* (Coquillett) (Diptera), *Frontina archippivora* (Williston) (Diptera) and *Trichogramma minutum* Riley (Hymenoptera) have been reported as being very effective, but we do not know whether they attack both species equally. The larvae of the moths are preyed upon by the wasp *Pachodynerus nasidens* (Latreille).

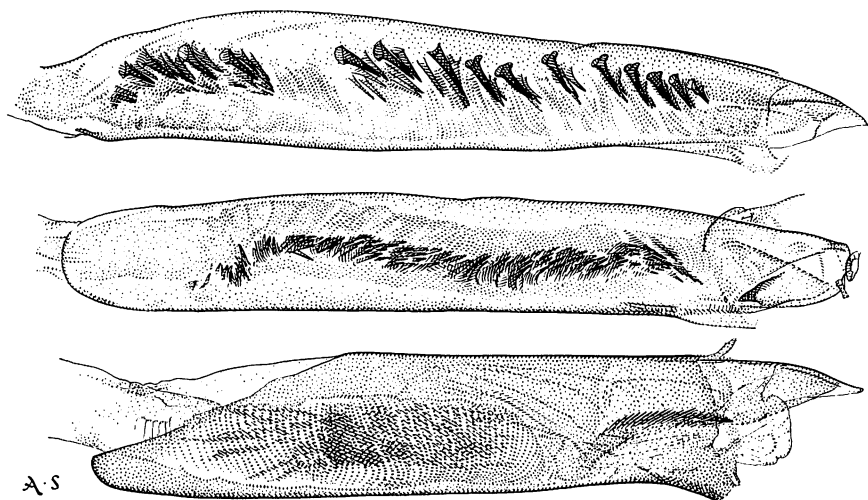


Figure 164—Top to bottom: Aedeagi of *Heliothis zea* (Boddie); *hawaiiensis* (Quaintance and Brues); *virescens* (Fabricius).

***Heliothis hawaiiensis*** (Quaintance and Brues) (figs. 163, 164, 165, 167, 169).

*Chloridea armigera* "Ab. 1" Hampson, 1903:45 (described from a dark, boldly marked individual from Kona, Hawaii, 4,000 feet, July 2, 1892, Perkins).

*Heliothis obsoleta* variety *hawaiiensis* Quaintance and Brues, 1905:12.

*Chloridea obsoleta* subspecies *signata* Warren, 1912:308 (then a new name for "Ab. 1" of Hampson).

*Chloridea armigera* "ab. *hawaiiensis*" Strand, 1916:143 (Hampson's "Ab. 1," named without having been seen by Strand).

*Chloridea obsoleta*, as a misidentification.

*Heliothis obsoleta*, as a misidentification.

*Heliothis armigera*, as a misidentification.

*Heliothis conferta*, as a misidentification.

The Hawaiian *Heliothis*.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii, Nihoa, Necker.

Immigrant? It is not known when this species first became established in Hawaii; it is possible that it is a natural immigrant. It was first collected in Hawaii by Blackburn on Haleakala, Maui, before 1880 (Butler, 1880:8). There are three Blackburn specimens in the British Museum. One of these was determined as "*H. conferta*," presumably by Butler. It bears the number "4." Butler

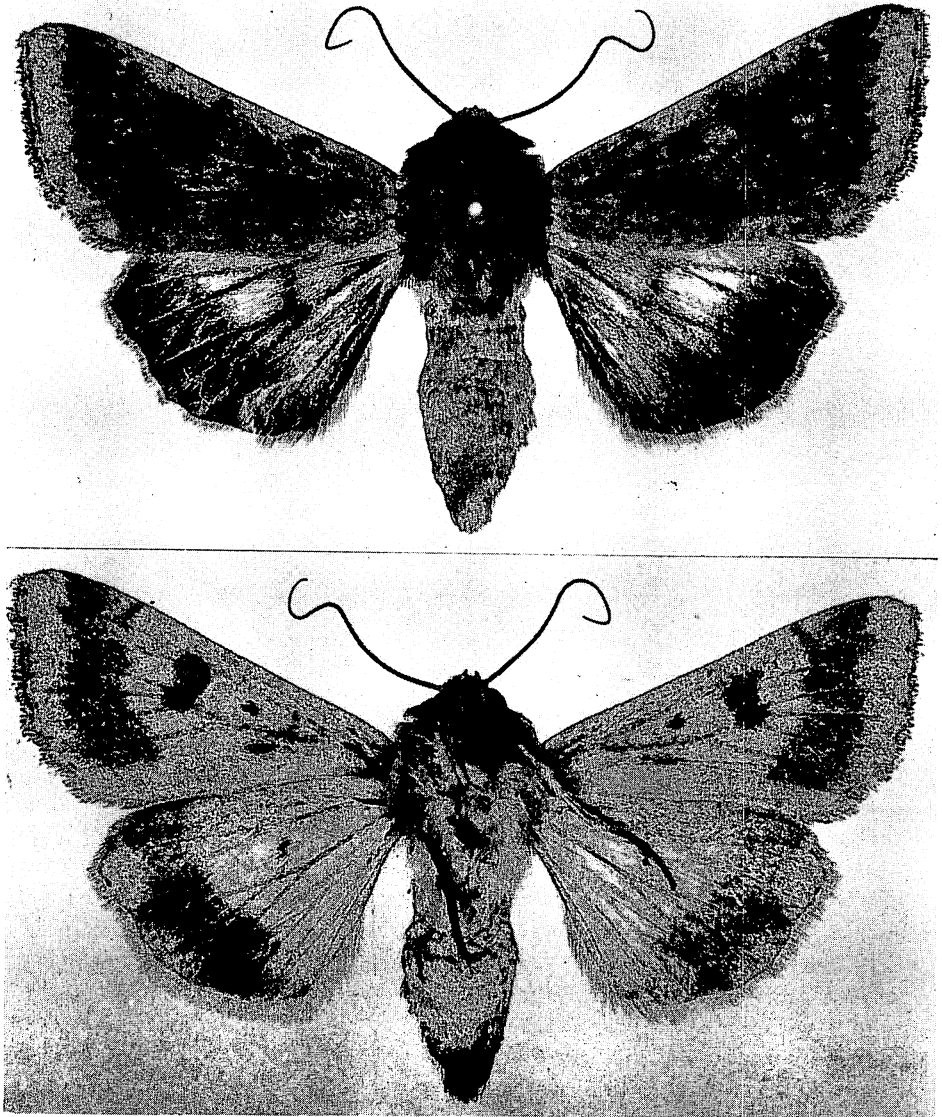


Figure 165—*Heliothis hawaiiensis* (Quaintance and Brues). Dorsal and ventral views of a specimen collected on Oahu by Blackburn; expanse, 34 mm.



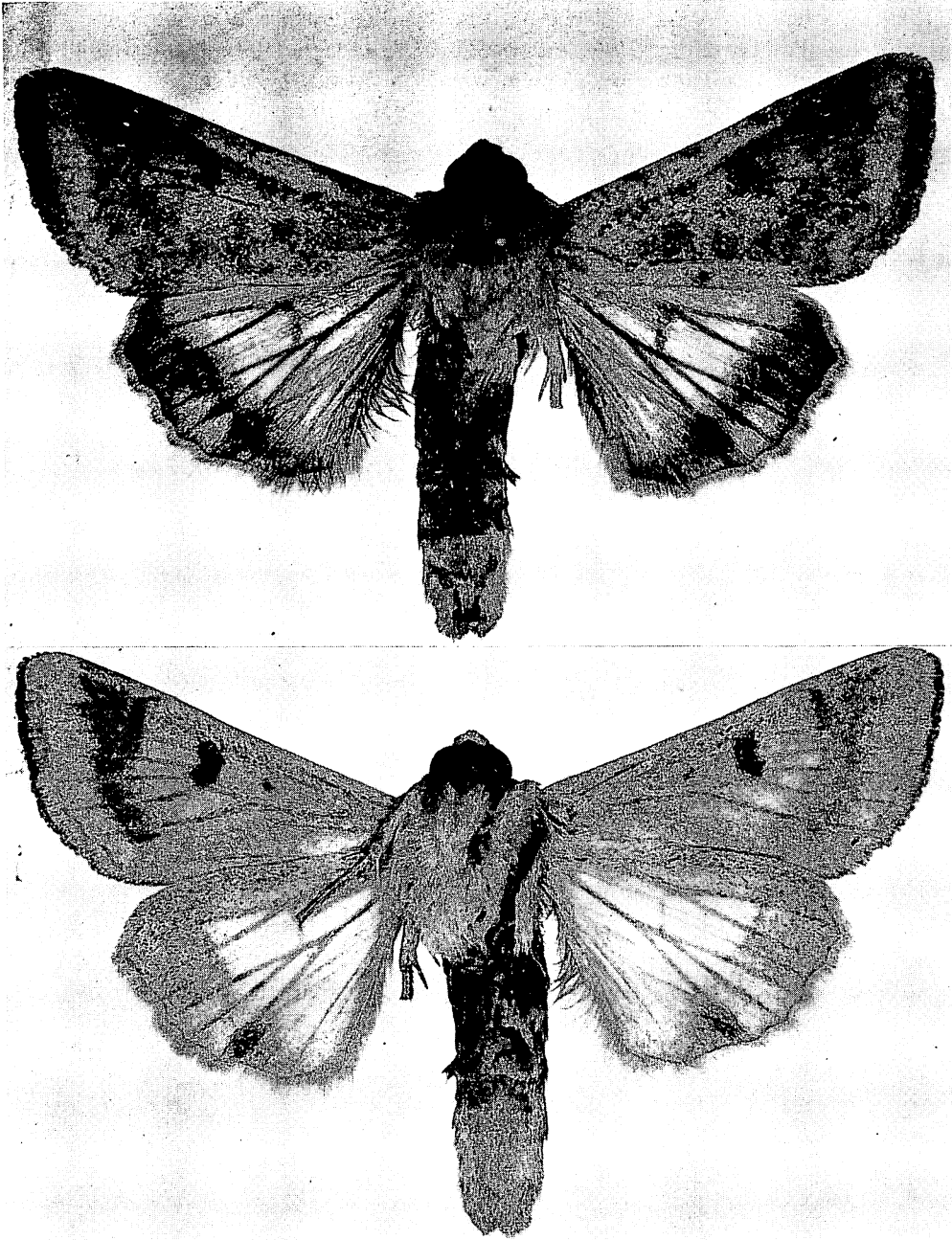


Figure 166—*Heliothis zea* (Boddie). Dorsal and ventral views of an example from Oahu; 1955; expanse, 39 mm.

(1880:8), when recording this species from the Blackburn collection, stated that the material he examined was numbered "4," and the note from Blackburn appears to indicate that the specimen was from Maui. However, the specimen bears another label reading "Hawaii, Oahu, T. Blackburn 80-31." Perhaps this

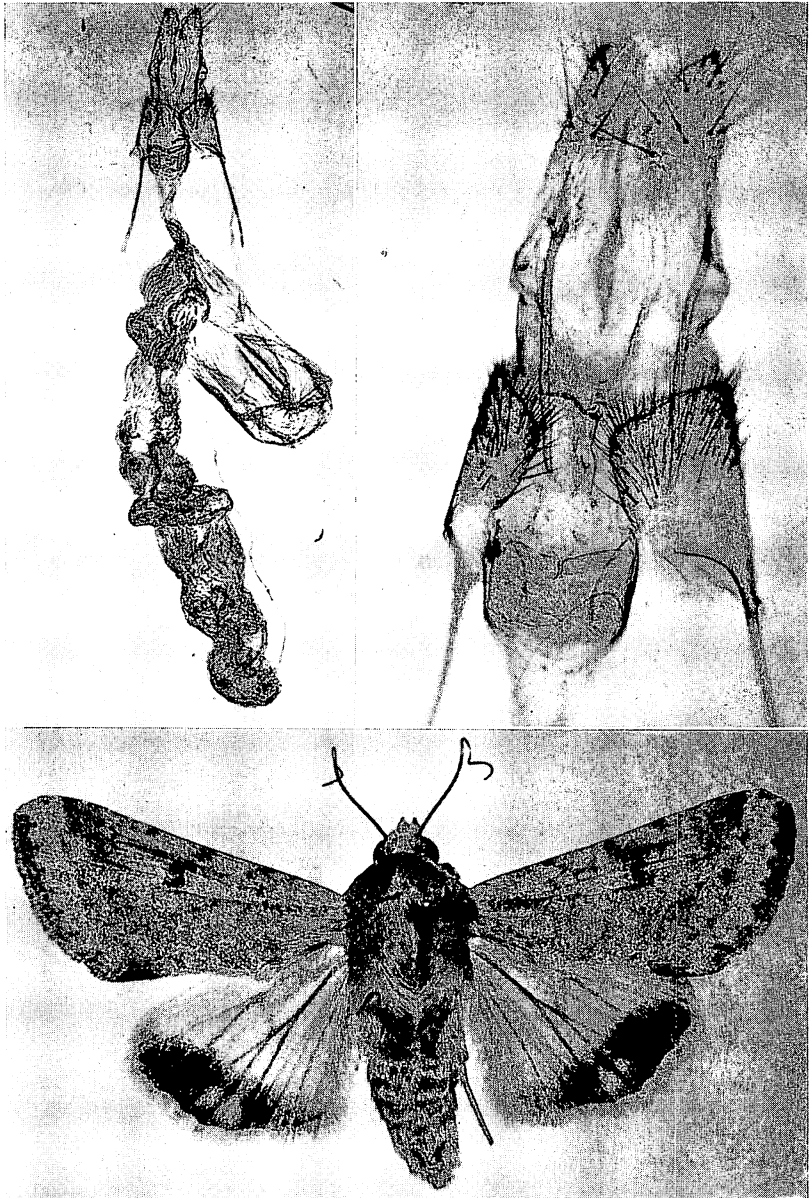


Figure 167—Above: Female genitalia of *Heliothis hawaiiensis* (Quaintance and Brues); Oahu; collected 1900-1901. Below: *Heliothis zea* (Boddie); Koko Head, Oahu; 1935; fore wing length, 18 mm.

example is the specimen sent by Blackburn to Butler for determination, and the note regarding the rearing of the moth from a species of "everlasting" (*Gnaphalium*) refers to other specimens taken by Blackburn but not sent to Butler. The other two Blackburn examples are labeled *Heliothis armigera* ♂ and *Heliothis armigera* ♀; the male bears the number "141," and the female "154." Evidently Blackburn placed small tickets bearing numbers on the specimens he sent for determination so that the names of the species could be returned by number, thus making the return of the specimens unnecessary. We have not been able to find any specimens of this species from any region other than Hawaii, and whence it has come is not known—if it is not an endemic species.

Judging from the evidence now at hand, it appears that the aedeagus most closely resembles that of *Heliothis gelotopoeon* Dyar, 1921, from South America, but there may be other American species now unknown to us to which it will be found more closely allied if not identical. The spines on the legs are not the same as those of *gelotopoeon*. In the specimens of *gelotopoeon* before us, the spines are more numerous and heavy, and the outer side of the fore tibia has a comb of stout, conspicuous spines from near the base to apex which is lacking in *hawaiiensis* (the number of spines may be variable, however). Also, the valves of the male genitalia are differently shaped and longer in proportion to the aedeagus in *gelotopoeon*. Externally, *hawaiiensis* is quite similar to *zea*, and it may often be difficult to separate the two species. The same comments apply also to separating the Hawaiian species from *armigera*, which evidently is distributed widely in Eurasia and Africa. The variation in color and pattern is extreme. Examples may be found which externally closely resemble *zea*, others *gelotopoeon*, others *armigera* or other species. It is the aedeagus which displays the diagnostic characters. Todd (1955) has figured the genitalia of *zea* and *gelotopoeon*, and Common has figured other species in his interesting paper on the Australian species (1953).

Hostplants: *Gnaphalium*, *Sida*; a polyphagous species whose hostplants have not been accurately determined because of confusion with *zea*, but which may include a large number of the plants listed above.

Parasites: *Eucelatoria armigera* (Coquillett), *Frontina archippivora* (Williston) (Dr. Swezey found 80 per cent parasitism by this species), *Trichogramma minutum* Riley.

Predator: *Pachodynerus nasidens* (Latreille).

Perkins, 1913:cxlvii, noted that *hawaiiensis* (then called *armigera*) "though a common insect, does not appear ever to attain here the extraordinary abundance that it reaches in other countries. The larvae, often lying exposed in the flowers of *Sida*, or on other plants, are very subject to the attacks of . . . two tachinid flies . . . , and in some seasons nearly all the specimens found are parasitized. The colour variations of the moth are numerous, and are not of local occurrence. Thus eight examples taken together on Molokai varied from the palest form to the darkest suffused one, no two individuals being alike. On the dry lowlands [it] is rare, except during the winter months, or when *Sida* and other lowland plants spring up afresh after heavy rains."

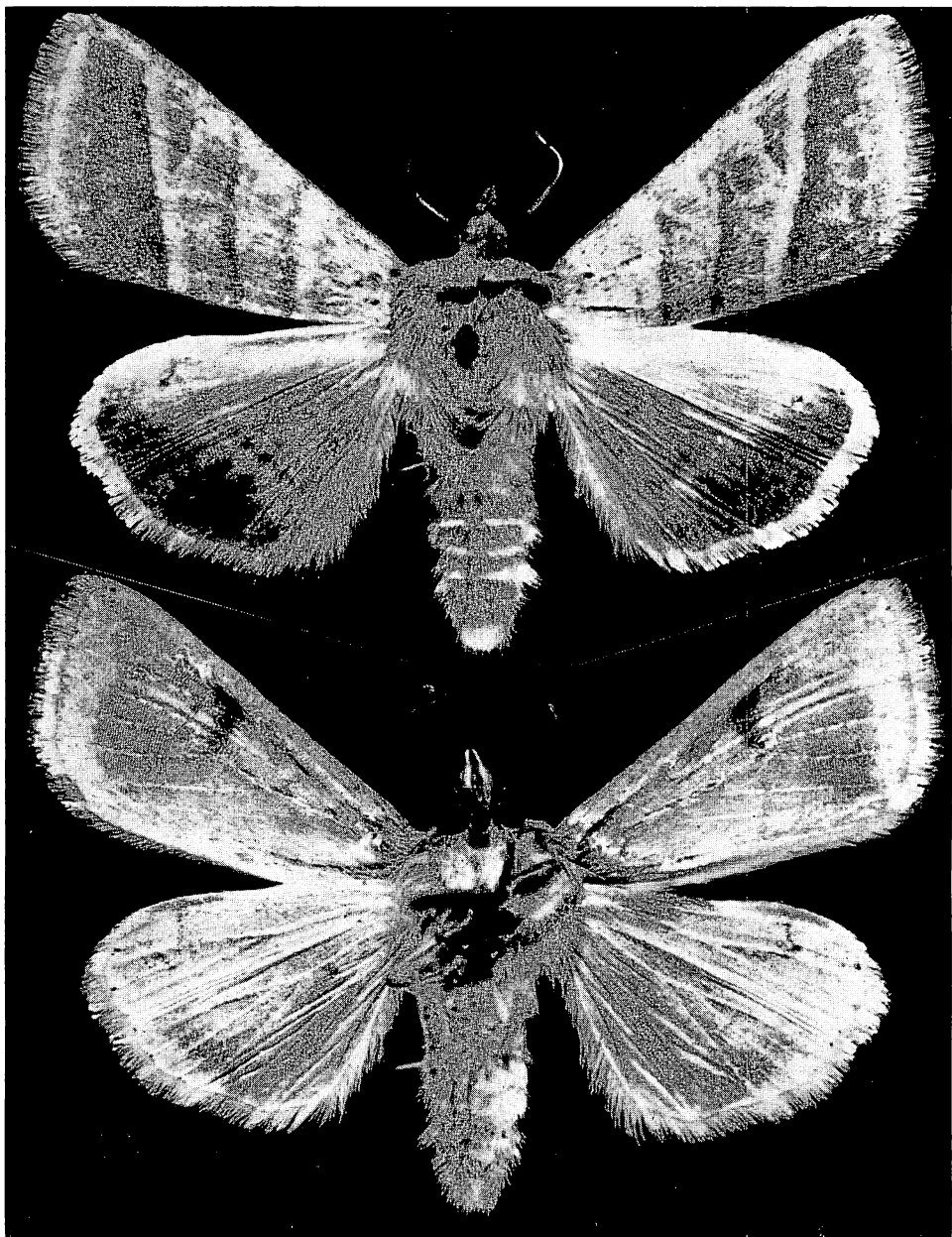


Figure 168—*Heliothis virescens* (Fabricius). Dorsal and ventral views of a female reared by J. W. Beardsley from geranium flowers at Honolulu; expanse, 27 mm.

***Heliothis virescens*** (Fabricius) (figs. 164, 168, 169).

*Noctua virescens* Fabricius, 1777:282; 1781:216.

*Chloridea virescens* (Fabricius) Hampson, 1903:48, cited as type of *Chloridea*.

For synonymy, see Hampson, 1903:48; but all the species he lists in synonymy may not be synonyms.

The tobacco budworm.

Oahu.

Immigrant. First taken at a light trap at Ewa in June, 1956, by J. W. Beardsley who sent it to me at the British Museum for identification and now reported for the first time from Hawaii. A widespread American species found from Canada to Argentina and from the east coast to the west coast of the United States.

Hostplants: Not ascertained in Hawaii at this writing, but it may be expected to attack many plants, including beans, *Cajanus cajan* (pigeon peas), cotton, flax, *Physalis*, *Solanum* and tobacco.

This species is the easiest of the three species of *Heliothis* in Hawaii to identify because the diagonal lines on the fore wings are diagnostic. The fore wings may be quite greenish, and the hind wings may have the dark band considerably suffused with red in the female. It is a highly variable species. It is a well-known pest in most places where it is common. A rather similar species, *subflexa* (Guenée), is commonly confused with *virescens* in America (see McElvare, 1941).

For illustrations of larva, see Peterson, 1948:184, figs. L36, A-F. Also, see Crumb, 1956:41, 47.

***Heliothis zea*** (Boddie) (figs. 164, 166, 167, 169).

*Phalaena zea* Boddie, 1850:132.

*Heliothis armigera*, as a misidentification.

*Chloridea armigera*, as a misidentification.

*Heliothis obsoleta*, as a misidentification.

*Chloridea obsoleta*, as a misidentification.

Heinrich, 1939.

For distribution and nomenclature, see Todd, 1955.

The corn earworm.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. An American species confused in Hawaiian literature before 1956 because of misidentification as noted above. Evidently first established in Hawaii shortly before 1930.

Hostplants: Corn, cotton, tomato, and a large number of other plants listed under the general discussion above.

Parasites: *Eucelatoria armigera* (Coquillett), *Frontina archippivora* (Williston), *Trichogramma minutum* Riley.

Predator: *Pachodynerus nasidens* (Latreille).

This species is a pest of major importance, and it is only too well-known to gardeners and agriculturists because of its attacks on tomato and sweet corn.

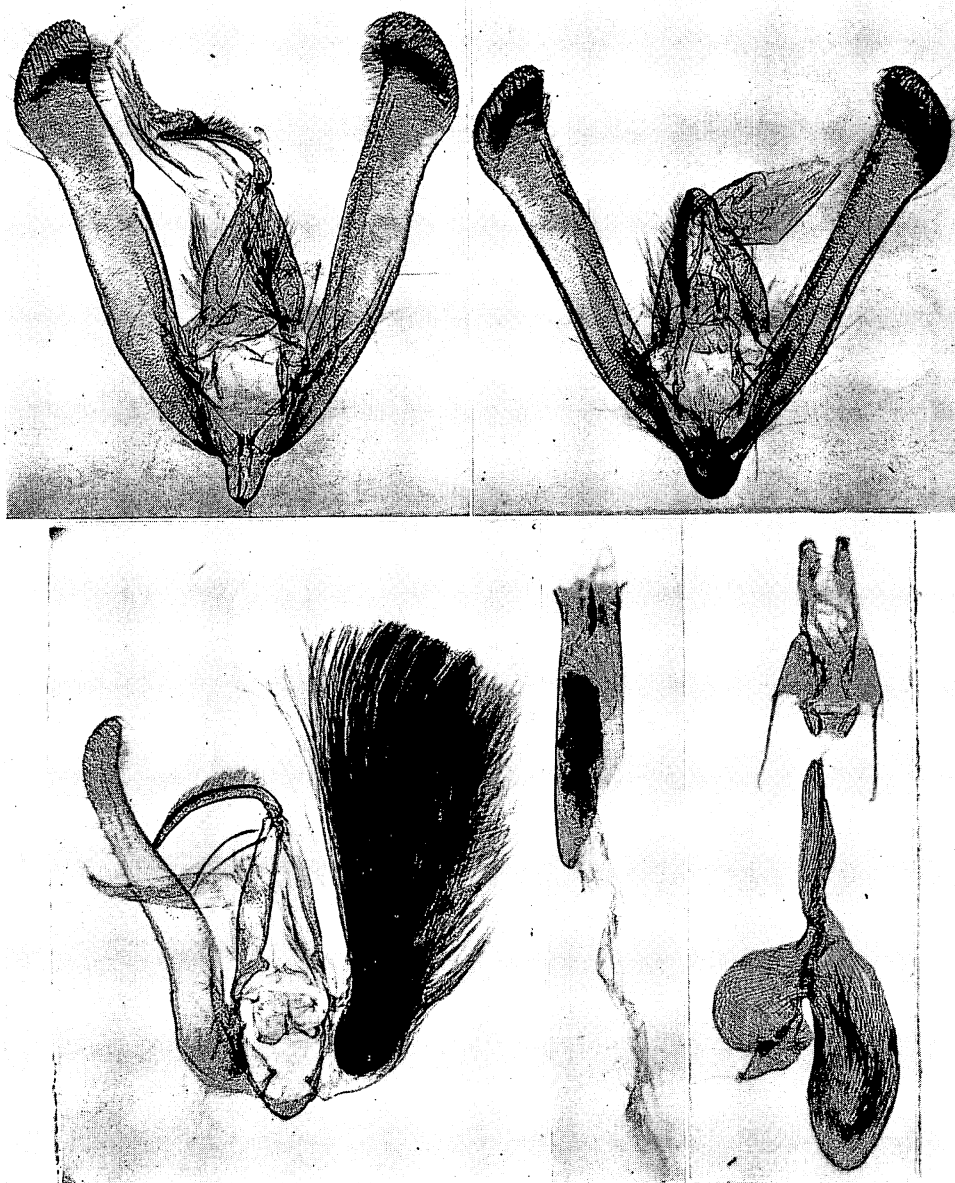


Figure 169—Genitalia of *Heliothis*. Above: *zea* (Boddie) (left); and *hawaiiensis* (Quaintance and Brues) (right). Below: Male and female genitalia of *virescens* (Fabricius).

Control of the caterpillars has been good following the application of DDT or cryolite. On green corn ears, a dilute solution of rotenone in oil has given good control (see Schmidt, 1942:195).

A vast literature exists on this species in America. For a detailed, illustrated study of *Heliothis* in South Africa, see Jones, 1936.

The variation in color and color pattern of the caterpillars is extraordinary, and not infrequently trained entomologists are misled by odd variations. The skin of the caterpillar is roughened by numerous minute spines. For illustrations of larva, see Peterson, 1948:184, figs. L36, K-P. Also, see Crumb, 1956:41, 49. Silverly, 1947, made a study of the genitalia of Hawaiian specimens.

In addition to the foregoing three species, *Heliothis inflata* (Wallengren) (*Anthoecia inflata* Wallengren, 1860:172) has incorrectly been listed as a Hawaiian species. We have examined the type in the Riksmuseum, Stockholm; it is labeled in error as having been taken in Honolulu by Kinberg. It is the same as *Anthoecia onca* Wallengren and *Anthoecia cystiphora* Wallengren and is a species of Central and South America and the Galapagos.

#### Genus **AGROTIS** (Huebner, 1806, Tentamen) Ochsenheimer, 1816:66

*Agrotis* is a large and widespread genus. It forms the largest complex of the Hawaiian noctuids. Much confusion has existed in Hawaiian literature heretofore, because our species have been referred wrongly to *Episilia*, *Euxoa*, *Agrotiphila*, *Feltia*, *Prodenia*, *Rhyacia*, *Spaelotis*, *Leucania* and *Peridroma*. The type of *Agrotis* is *Agrotis segetum* Denis and Schiffermueller, 1775, Ochsenheimer, 1816:66, of Europe, and our species are congeneric with *segetum* (fig. 218). I list 27 species here, 26 of them endemic.

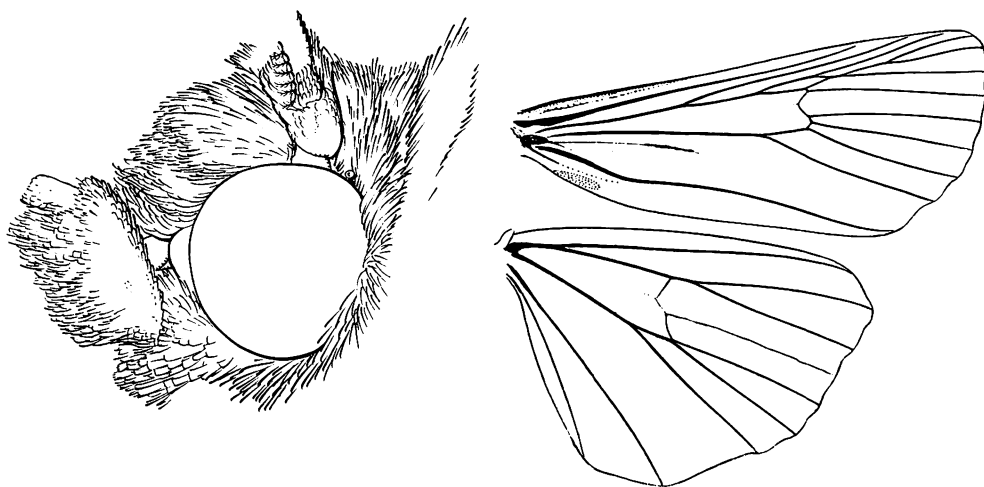


Figure 170—Head of *Agrotis ipsilon* (Hufnagel) (left); wing venation of *Agrotis segetum* Denis and Schiffermueller (right).

The preparation of a key to our species has been very difficult, and I am not satisfied with the results of my labor. Much work remains to be done on our species, and the key can be perfected only by use and revision. The key given by Meyrick in *Fauna Hawaiiensis* is not workable. It may be noted in passing that Meyrick placed *mesotoxa* in his key on the basis of male characters, but only two females were known to him.

The male has a very long internal sac in the aedeagus. This is kept withdrawn in accordion-like folds, but it may be extended to a length greater than the abdomen. The great bursa system of the female is frequently very difficult to clean out in dissections. In mated examples, the hard, wire-like spermatophore (or frequently two or three) must be cut in several places so that it may be withdrawn. It is frequently not possible to make an attractive appearing dissection of the female genitalia.

There is interspecific variation in the triangular processes on the antennae of the males of some of the species, and these characters warrant further investigation. I have illustrated a few examples. They are reduced in *evanescens* and *fasciatus* and vestigial in *crinigera*.

We know little about most of the species, and much work remains to be done on all of them, including their early stages. This genus in Hawaii could be made the object of much interesting research, and it is worthy of detailed investigation.

#### KEY TO THE HAWAIIAN AGROTIS

1. The smallest species of the genus in Hawaii, only about 20–26 mm. in expanse; fore wings with considerable yellowish-brown and orange-brown scaling, clavi-form (extends half length of wing), orbicular and reniform spots all very dark and prominent, reniform expanded down to vein two; hind wings dark fuscous, appearing nearly black; figure 206; Kilauea, Hawaii. . . . . **microreas** Meyrick.  
 Not such species, fore wing expanse usually more than 30 mm. . . . . 1a
- 1a(1). Tegulae each with a conspicuous, broad, white vitta; a bright-colored species with considerable reddish, yellowish (under magnification) and chestnut-colored scales; a very boldly marked species with claviform, orbicular and reniform spots large and strong and the transverse bands conspicuous, as in figure 181. . . . . **charmocrita** (Meyrick).  
 Not such species. . . . . 2
- 2(1a). Claviform spot in fore wings extended, and together with basal dash forming a long, usually conspicuously dark and outstanding band or streak from base to about  $\frac{1}{3}$  to  $\frac{1}{2}$  length of wing (in some ex-



amples it is only outlined with dark scales and not solidly dark and it may be rather inconspicuous, as in some varieties of *xiphias*, or, as on *tephrias* and *pe-regramma*, it may be very narrow and extend toward base as a fine, rather indistinct plical line, and on some species it is broken by pale scaling of ante-medial line, as in *laysanensis*); seldom as much as 40 mm. in expanse and never about 50. . . . . 3

Claviform spot not so formed, often obscure, never extending as a solid dark band or streak to base (if finely outlined, as in *bryani*, then nearer 50 mm. in expanse than 40 mm.) . . . . . 10

NOTE: this dichotomy is a weak place in the key and one might have to try both sections.

3(2). Fore wings with conspicuous, dark, subovate spots between bases of veins two to seven, pattern as in figure 174. . . . . **arenivolans** Butler.

Fore wings without such dark patches. . . . . 4

4(3). Lower margin of cell in fore wings marked by a white, thread-like line, area between veins 2 and 1c with more yellowish scales from base to apex, area between this and dorsal (inner) margin of wing with more whitish or greyish-white scales, the two areas contrasting in coloration, as in figure 188. . . . .

. . . . . **dislocata** (Walker).

Not such species. . . . . 5

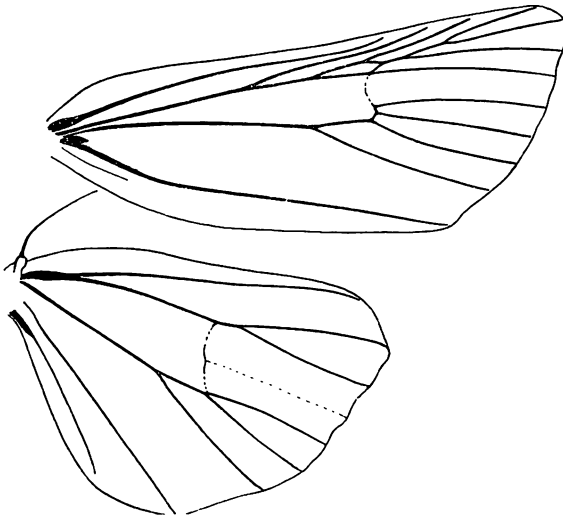


Figure 171—Wing venation of *Agrotis microreus* Meyrick.

- 5(4). Upper and lower surfaces of both fore and hind wings with nearly the same brown ground color, fore wings not much darker than hind wings, under sides of fore and hind wings concolorous and the same color as dorsal side of hind wings; fore wings not conspicuously marked, orbicular and reniform spots obsolete, scaling along lower edge of veins white, thus making fine white streaks. . . . . **aulacias** Meyrick.  
Not such species. . . . . 6
- 6(5). Neither antemedial nor postmedial lines present; fore wings nearly concolorous fuscous and hardly marked excepting by the narrowly outlined claviform, reniform and orbicular spots. . . . . **perigramma** Meyrick.  
Either postmedial line present, or both antemedial and postmedial lines present; fore wings distinctly marked. . . . . 7
- 7(6). Claviform a very narrow, inconspicuous, or rather inconspicuous line along plica. . . . . **tephrias** Meyrick.  
Claviform conspicuous, band-like, not thread-like. . . . . 8
- 8(7). Antemedial band separating conspicuously the basal dash from claviform; orbicular and reniform spots not large and made rather indefinite by surrounding dark scaling. . . . . **laysanensis** (Rothschild).  
Basal dash and claviform spot forming a continuous vitta from base; orbicular and reniform spots prominent. . . . . 9
- 9(8). Antemedial and postmedial lines distinct and entire; orbicular spot broadly oval. . . . . **panoplias** Meyrick.

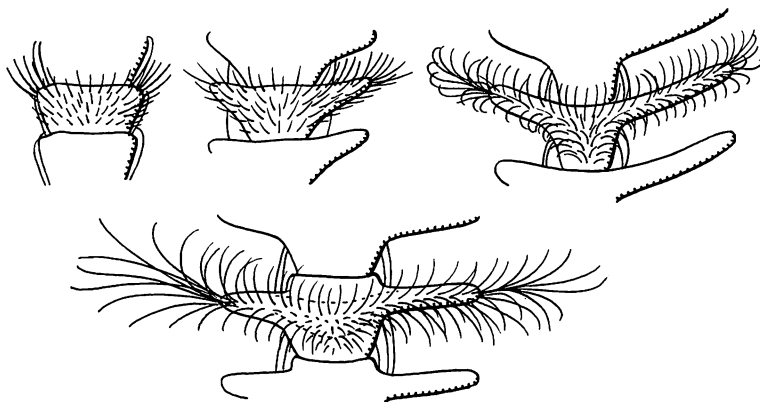


Figure 172—Specific differences on male antennal segments of *Agrotis*, as seen from beneath. Above: *crinigera* (Butler), *evanescens* (Rothschild), *ipsilon* (Hufnagel). Below: *epicremna* Meyrick, type.

- Antemedial line obsolete, postmedial line indicated by dots; orbicular spot narrowly elongate.....**xiphias** Meyrick.
- 10(2). Pale, greyish-ochreous, nearly concolorous species; fore and hind wings of nearly similar color; claviform, orbicular and reniform spots obsolete; antemedial line obsolete or indicated by a dark spot on costa, medial vein and vein one, and at most shaded between; postmedial line present and made more pronounced on veins by small, dark, dash-like spots or marked principally by the dark spots.....**photophila** (Butler).  
Not such pale species.....11
- 11(10). Fore wings distinctly reddish or ferrugineous in ground color.....12
- Fore wings brown, tan, grey or fuscous, but not reddish..13
- 12(11). Orbicular and reniform spots joined by a large, conspicuous, dark, usually subquadrate spot; antemedial and postmedial lines indistinct.....**ceramophaea** Meyrick.

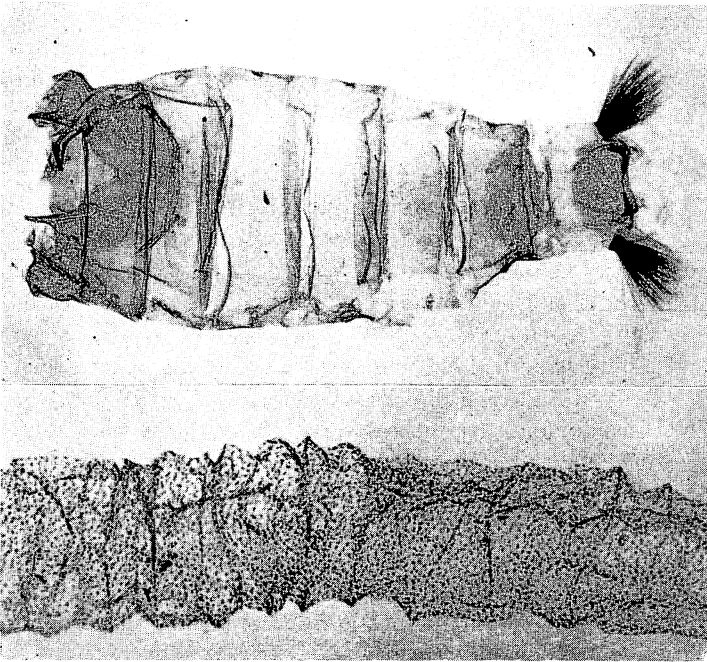


Figure 173—Above: Cleared abdomen of a male *Agrotis dislocata* (Walker) from Oahu; genitalia removed, and mounted in balsam. Below: A small section of the very long internal sac of the aedeagus of the type of *Agrotis xiphias* Meyrick; mounted in balsam (note the bellows-like structure).

Orbicular and reniform spots usually vague, but without a dark spot between them even if distinct; antemedial and postmedial lines prominent. . . . .

. . . . . **hephaestaea** Meyrick.

- 13(11). Upper and lower surfaces of both fore and hind wings with nearly the same brown ground color, fore wings not much darker than hind wings, under sides of fore and hind wings concolorous and the same color as dorsal side of hind wings; fore wings not conspicuously marked, reniform spot obsolete, scaling along lower edge of cell particularly, and on first vein, and to a lesser degree on other veins, white, thus making fine white streaks. . . . **aulacias** Meyrick.  
Not such species, always with more contrasting colors and patterns. . . . . 14
- 14(13). Fore wing pattern as in figure 197, with a distinct, short, black bar extending distad from reniform spot, orbicular transversely ovate, narrowest distad; discs of hind wings nearly white, veins prominent, without medial band. . . . . **ippsilon** (Hufnagel).  
Not so. . . . . 15
- 15(14). Veins of fore wings marked by lines of black scales and standing out very distinctly against the paler ground color; orbicular and reniform at least partly outlined by pale scales and connected by an elongated, subrectangular dark patch; basal area to antemedial line (the latter rather indefinite) suffused with dark scales; type color form of. . . . **melanoneura** Meyrick.  
Veins not so conspicuously marked. . . . . 16
- 16(15). Under side of hind wings with a distinct dark spot on discocellulars. . . . . 17  
Under side of hind wings without a conspicuous dark spot on discocellulars. . . . . 22
- 17(16). Orbicular and reniform spots joined by a very dark and conspicuous spot which is strongly marked off from the other spots and is the most prominent spot on wings; fore wings with ground color varying from nearly white (sprinkled with fuscous) to dark brown and fuscous (*austalea*). . . . . **melanoneura** Meyrick.  
Fore wings without such a prominent dark spot joining orbicular and reniform. . . . . 18
- 18(17). Orbicular and reniform large, clearly defined, conspicuous, sometimes connected by darker scaling. . . . 19  
Orbicular and reniform obscure, indefinite or obsolete. . . 21

- 19(18). Orbicular and reniform spots conspicuously pale compared to ground color of fore wing, their middles comparatively pale fuscous, then outlined by white, then by black, reniform extended conspicuously outward at posterior-distal corner between bases of veins three and four, and usually with a distinct extension between veins three and four centering below origin of three but not extending to base of two (extensions pale, outlined with dark scales); claviform broad, pale internally and edged with black, its top margin along edge of cell, normally much like orbicular and reniform in coloration. . . .  
 . . . . . **baliopa** Meyrick.  
 Either reniform spot dark, or both reniform and orbicular spots dark and/or not as described for *baliopa*; if orbicular and reniform are pale, then claviform is narrow and distinctly separated from lower margin of cell. . . . . 20
- 20(19). Antemedial line obviously irregular and angulate between cell and first vein; claviform usually not narrowed to apex, but subtruncate or even slightly concave at apex and as broad there as at base. . . .  
 . . . . . **psammophaea** Meyrick.  
 Antemedial line outwardly smoothly convex or arcuate between cell and first vein; claviform narrowed to rounded apex. . . . . 20a
- 20a(20). Tegulae clothed predominantly with broad, heavy-appearing scales which are comparatively shallowly multidentate at their apices, and the apices are, excluding the denticulations, obviously broadly truncate; postmedial line strongly zigzag, drawn out to long, acute points on veins and there tipped with white scales; greatest breadth of fore wing of male holotype (measurement taken perpendicular to costal margin) 7 mm. . . . . **giffardi** (Swezey).  
 Tegulae clothed predominantly with very narrow scales or hairs, most of which are deeply bifid, but some are deeply trifid, and only a few have more than three points, shallowly denticulate scales rare; postmedial line slightly zigzag, more crenulate than zigzag and obtusely produced on veins and not white-tipped there; greatest breadth of fore wing of female holotype 8 mm. . . . . **mesotoxa** Meyrick.
- NOTE: These two species are extraordinarily similar.

Only the unique male of *giffardi* and only two females of *mesotoxa* are known. Additional material and study are needed to clarify the status of these two forms.

- 21 (28). Antemedial line white, bordered with brown or fuscous; fore and hind wings mostly pale beneath; edges of hind wings dusted with fuscous but not markedly darker than discs . . . . . **cremata** (Butler).  
Antemedial line dark fuscous or black; edges of lower sides of hind wings fuscous, disc nearly white, the disc appearing strikingly pale compared to fore wings or margins of hind wings, fore and hind wings dark beneath excepting for the pale hind wing discs . . . . . **epicremna** Meyrick.
- 22 (16). Fore wings with transverse lines faintly indicated or obsolescent or orbicular spot obsolete or both, antemedial line not forming a conspicuous, dark-outlined, strongly projecting, >-shaped mark between first vein and hind margin of wing; found on Laysan and Midway . . . . . **evanescens** (Rothschild).  
Fore wings with transverse lines strong and conspicuous, orbicular strong, and/or antemedial line forming a strongly projecting, dark-outlined, >-shaped mark between first vein and hind margin of wings. . . . . 23
- 23 (22). Claviform outlined by a fine, dark line which extends from base to below outer edge of orbicular, the area thus enclosed sub-lenticular; orbicular and reniform paler than area between them; orbicular narrowly ringed with dark scales; reniform margined at base and apex with dark scales, and extending obliquely distad at posterior apical corner; the area distad of reniform darker and it sometimes might be mistaken for the reniform; Nihoa . . . . . **bryani** (Swezey).  
Not so . . . . . 24
- 24 (23). Orbicular and reniform "connected by a blackish streak above median nervure"; claviform conspicuous and "distinctly defined by black" (from Hampson, 1903:217, pl. 64, fig. 1; I have not seen this species) . . . . . **procellaris** Meyrick.  
Orbicular and reniform not connected by a streak; claviform indistinct or obsolete . . . . . 25
- 25 (24). Fore wings with spots and bands containing distinct white scales; orbicular white with a dark center and outlined with dark scales; transverse basal line dark

- basad, white distad; pattern as in figure 201; French  
Frigate Shoal. . . . . **kerri** (Swezey).  
Fore wings brown, without white scales. . . . . 26  
26 (25). Hind wings pale, nearly the same color beneath as  
above, with a dark medial line or shade above (as  
well as below); antennae of male with ventro-lateral  
setose processes developed; antemedial line on two  
specimens examined consists of dark scales only;  
Midway Island. . . . . **fasciata** (Rothschild).  
Hind wings not pale, obviously darker above than  
beneath, without a dark medial line or shade; an-  
tennae of male with ventro-lateral setose processes  
obsolete; antemedial line normally a pale line out-  
lined by dark scales, the line therefore appearing  
double (two dark lines separated by pale scaling, or  
a dark line edged basad by pale scales); on the main  
islands. . . . . **crinigera** (Butler).

**Agrotis arenivolans** Butler (figs. 174, 176, 178).

*Agrotis arenivolans* Butler, 1879:269.

*Euxoa arenivolans* (Butler) Hampson, 1903:162, pl. LX, fig. 5. Warren, 1912:46,  
pl. 6a.

Endemic. Maui (type locality: sand hills near the sea), Hawaii.

Hostplant: Unknown.

**Agrotis aulacias** Meyrick (figs. 174, 176, 178).

*Agrotis aulacias* Meyrick, 1899:145, pl. 4, fig. 6.

*Feltia aulacias* (Meyrick) Hampson, 1903:352, pl. LXVIII, fig. 13.

*Euxoa aulacias* (Meyrick) Warren, 1912:51, pl. 6h.

Endemic. Maui (type locality: Haleakala, 9,000 feet).

Hostplant: Unknown.

In spite of the different general appearance of this species, it is closely allied to  
*dislocata*.

**Agrotis baliopa** Meyrick (figs. 175, 177, 179).

*Agrotis baliopa* Meyrick, 1899:149.

*Euxoa baliopa* (Meyrick) Hampson, 1903:188, pl. LX, fig. 31. Warren, 1912:49,  
pl. 6f.

Endemic. Maui (type locality: Haleakala, 6,000 feet), Hawaii.

Hostplant: Unknown.

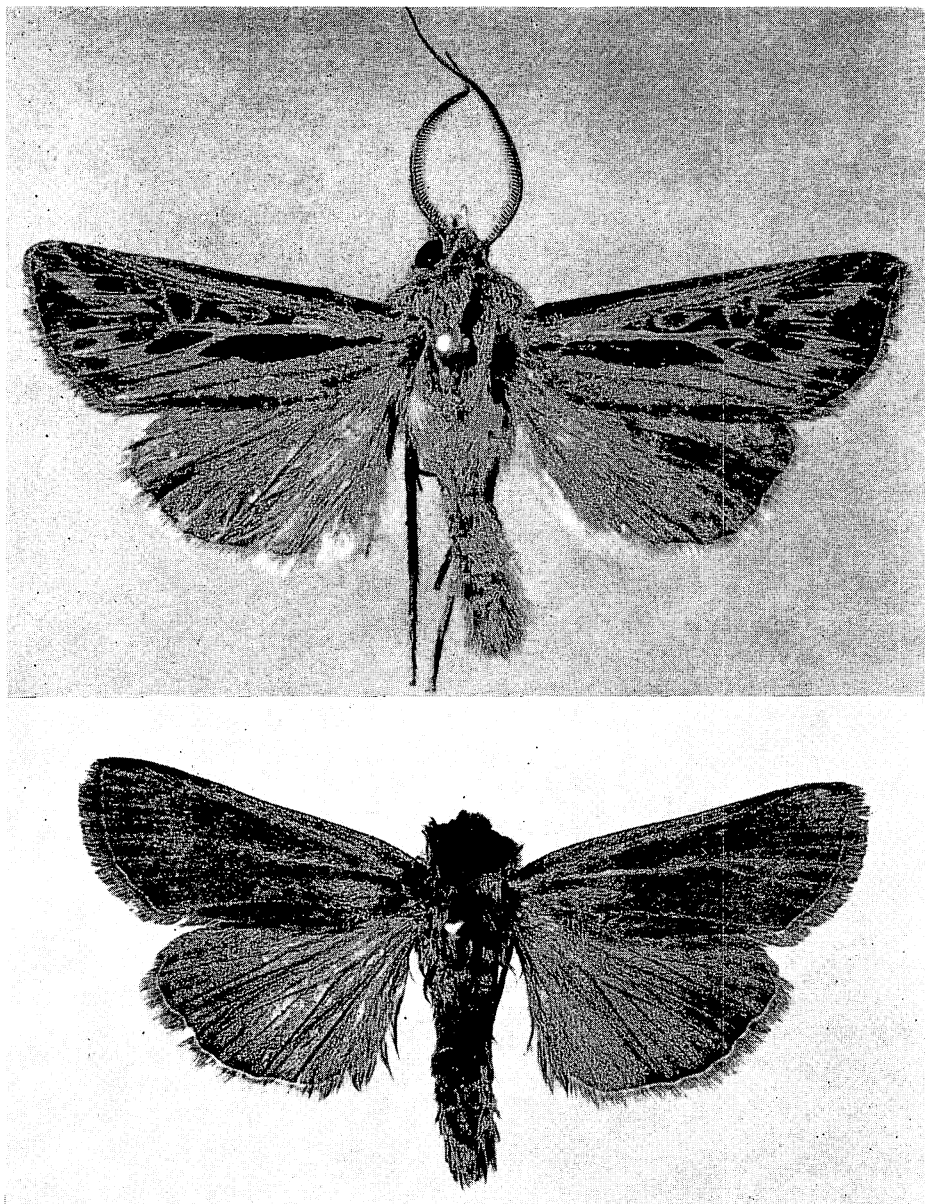


Figure 174—Above: *Agrotis arenivolans* Butler, male type; "Hawaii T. Blackburn 79-80"; expanse, 36 mm. Below: *Agrotis aulacias* Meyrick, male type; Haleakala, Maui, 9,000 feet; expanse, 35 mm.



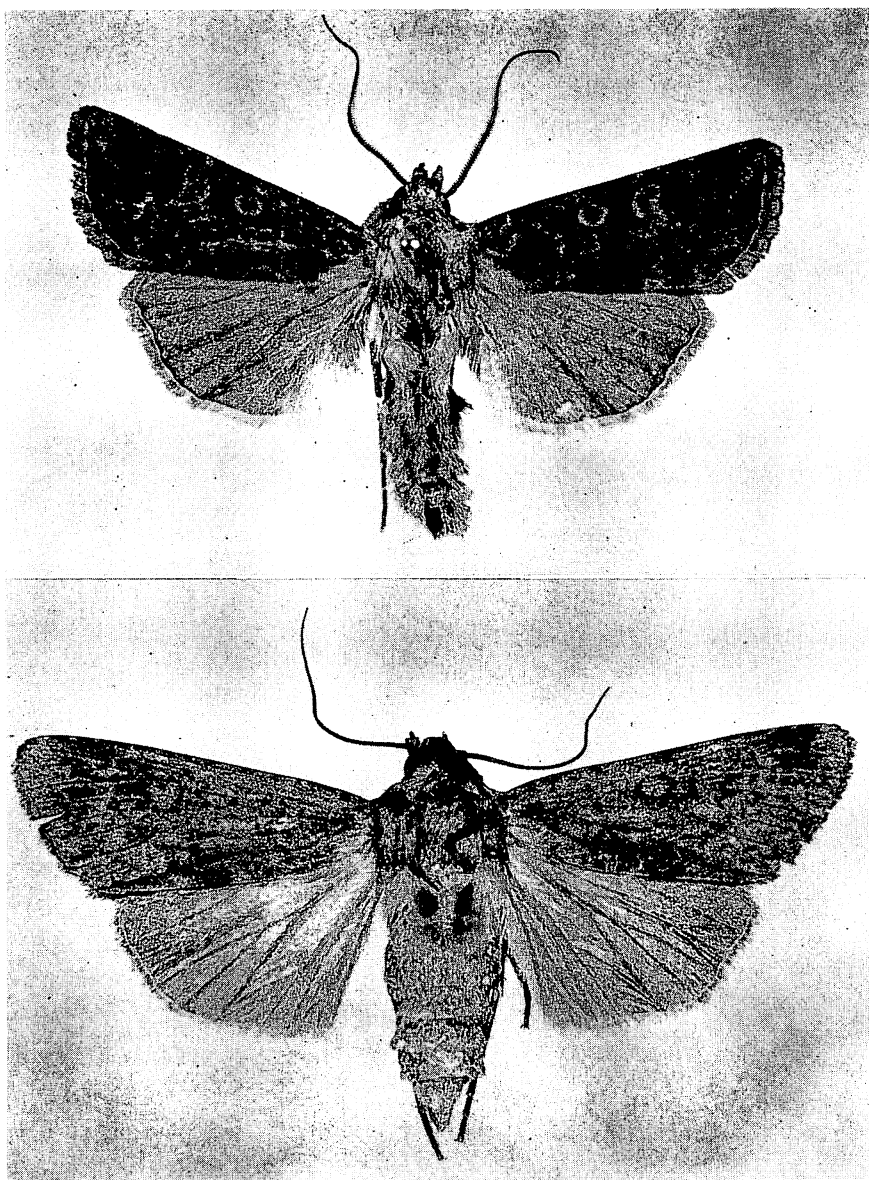


Figure 175—Above: *Agrotis baliopa* Meyrick, type male; Haleakala, Maui; expanse, 42 mm. Below: *Agrotis bryani* (Swezey), female type; Nihoa; expanse, 50 mm.

***Agrotis bryani* (Swezey), new combination** (figs. 175, 182, 184).

*Euxoa bryani* Swezey, 1926:74.

Endemic. Nihoa (type locality).

Hostplant: Unknown.

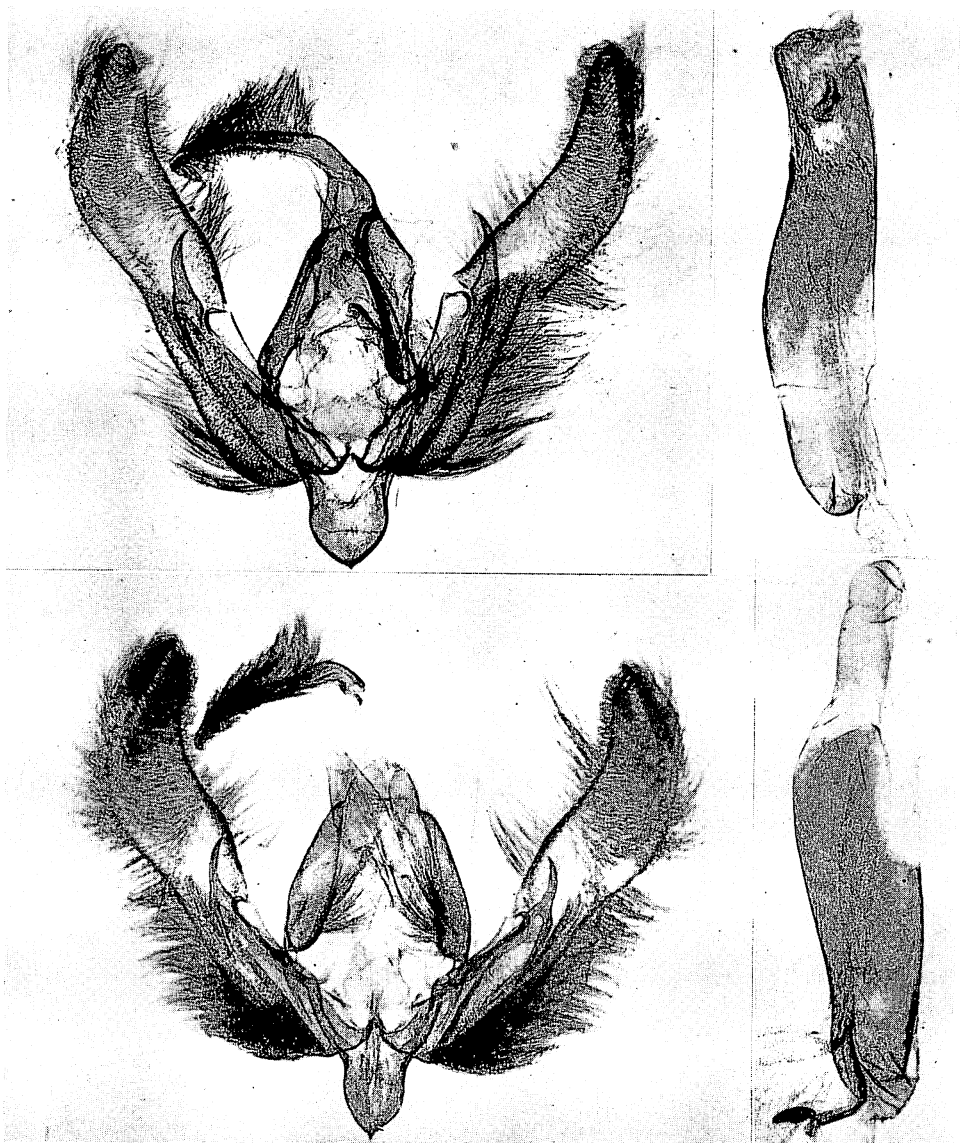


Figure 176—Male genitalia of *Agrotis*. Above: *arenivolans* Butler; a Blackburn example. Below: *aulacias* Meyrick; Haleakala, Maui, 8,000 feet (aedeagus reversed).

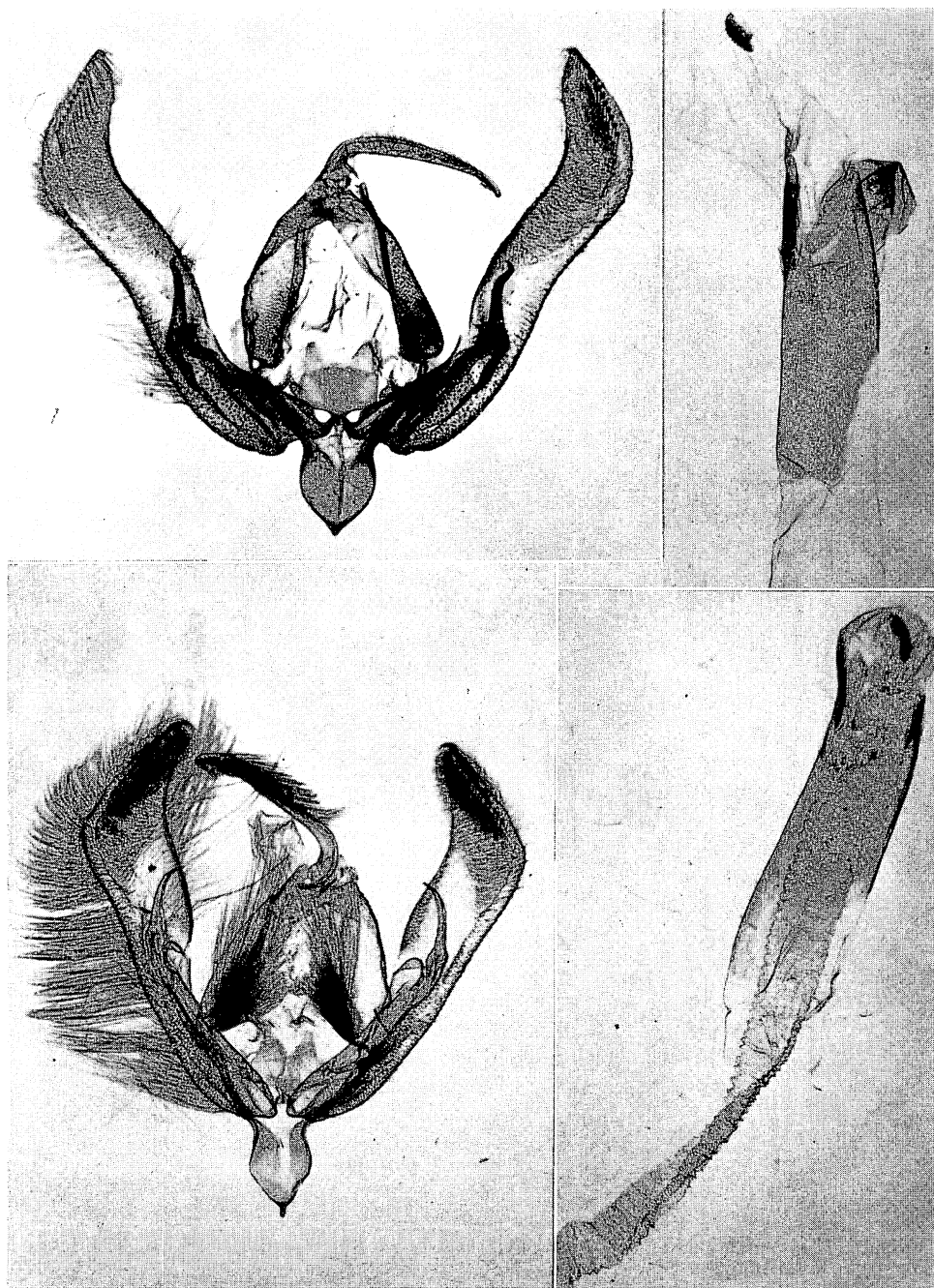


Figure 177—Male genitalia of *Agrotis*. Above: *melanoneura* Meyrick; from the type of *austulea* Meyrick, a synonym; Kona, 4,000 feet. Compare with figure of genitalia of the type of *melanoneura*. Below: *baliopa* Meyrick; Haleakala, Maui.

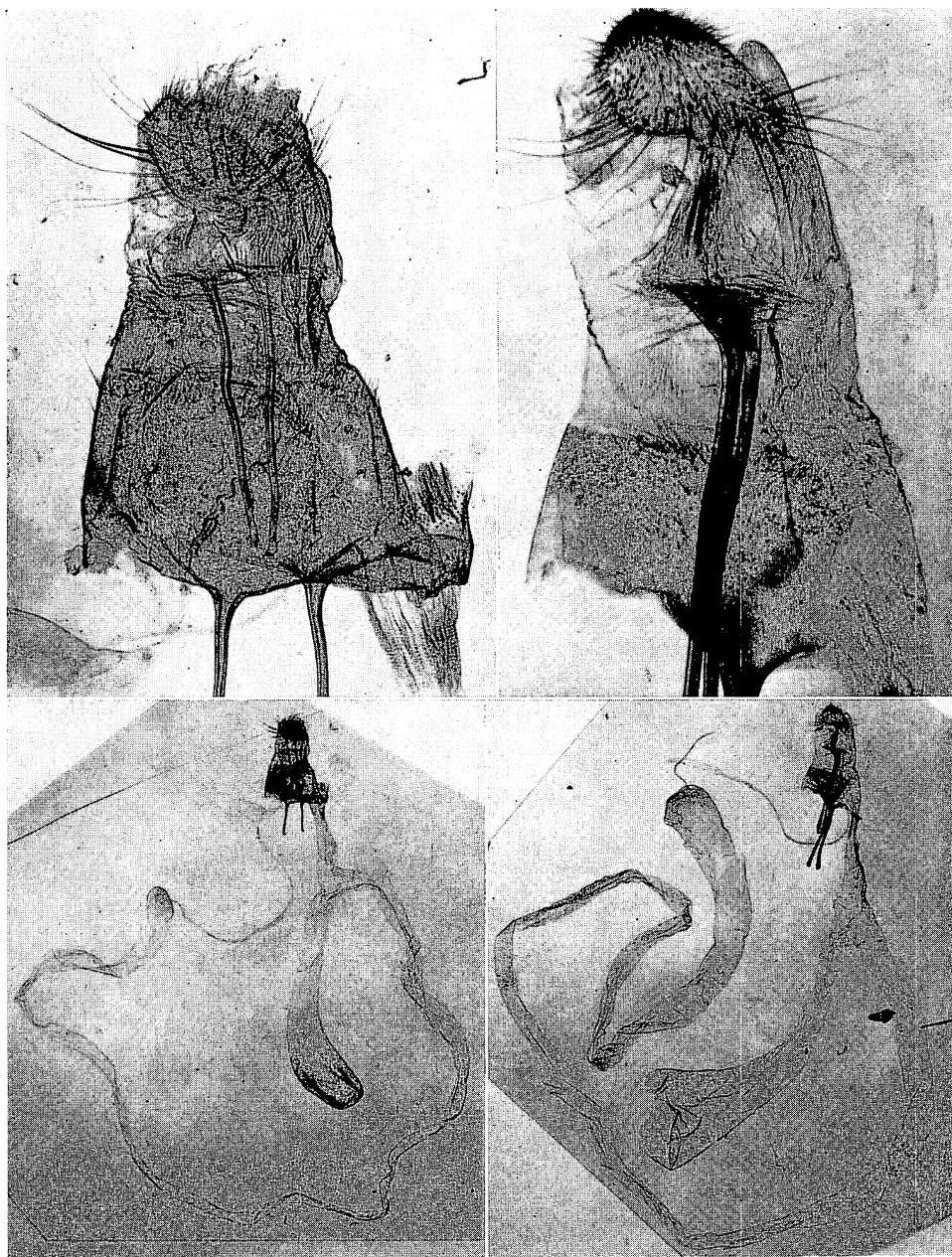


Figure 178—Female genitalia of *Agrotis*. Left: *arenivolans* Butler, type. Right: *aulacias* Meyrick; Haleakala, Maui, above 8,000 feet.

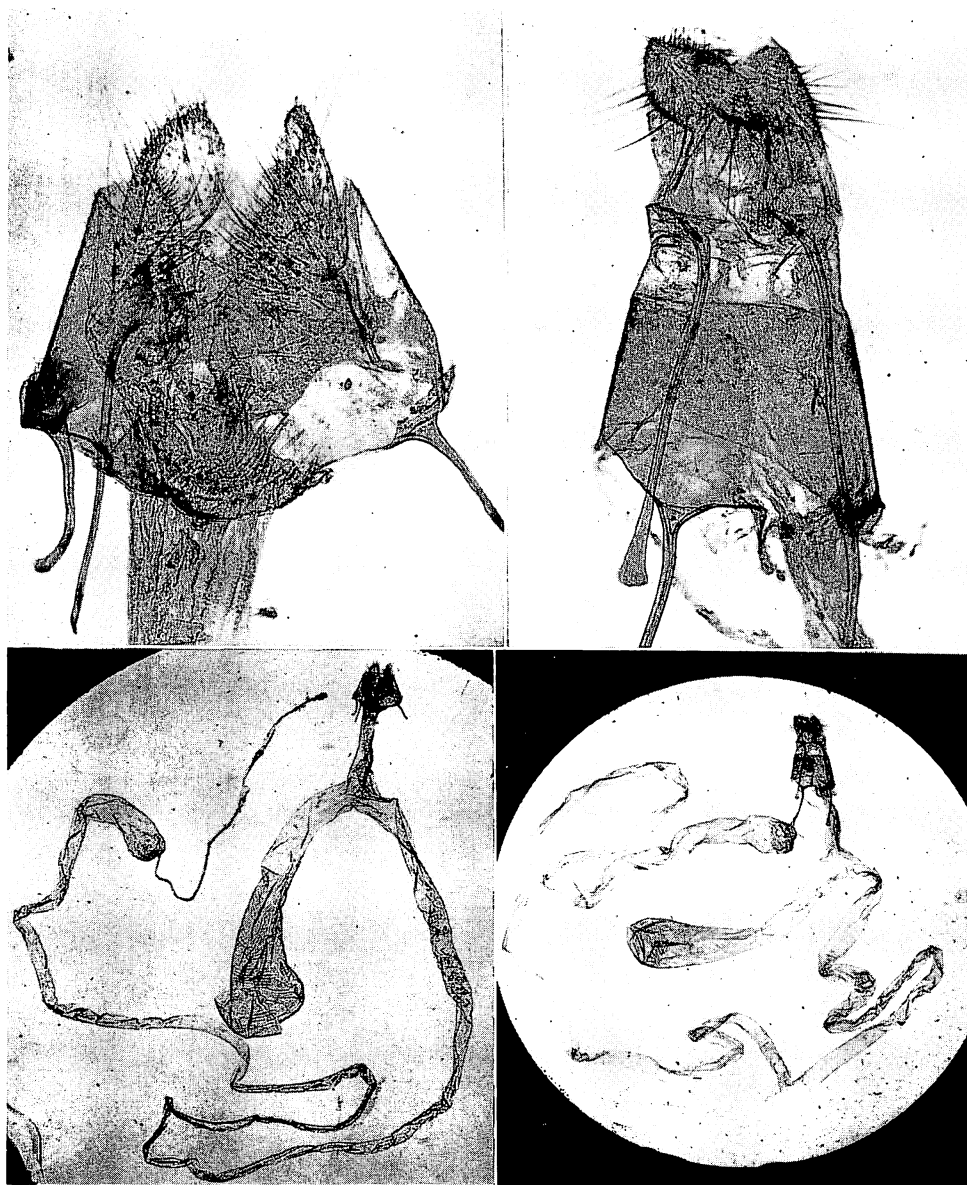


Figure 179—Female genitalia of *Agrotis*. Left: *melanoneura* Meyrick (from an example formerly under *austalea*); Kona, Hawaii. Right: *baliopa* Meyrick; Haleakala, Maui.



***Agrotis ceramophaea* Meyrick (figs. 180, 182).**

*Agrotis ceramophaea* Meyrick, 1899:151.

*Episilia ceramophaea* (Meyrick) Hampson, 1903:492, pl. LXXIII, fig. 11.

*Rhyacia ceramophaea* (Meyrick) Warren, 1912:53, pl. 7b.

*Agrotis stenospila* Meyrick, 1928:92. **New synonym.**

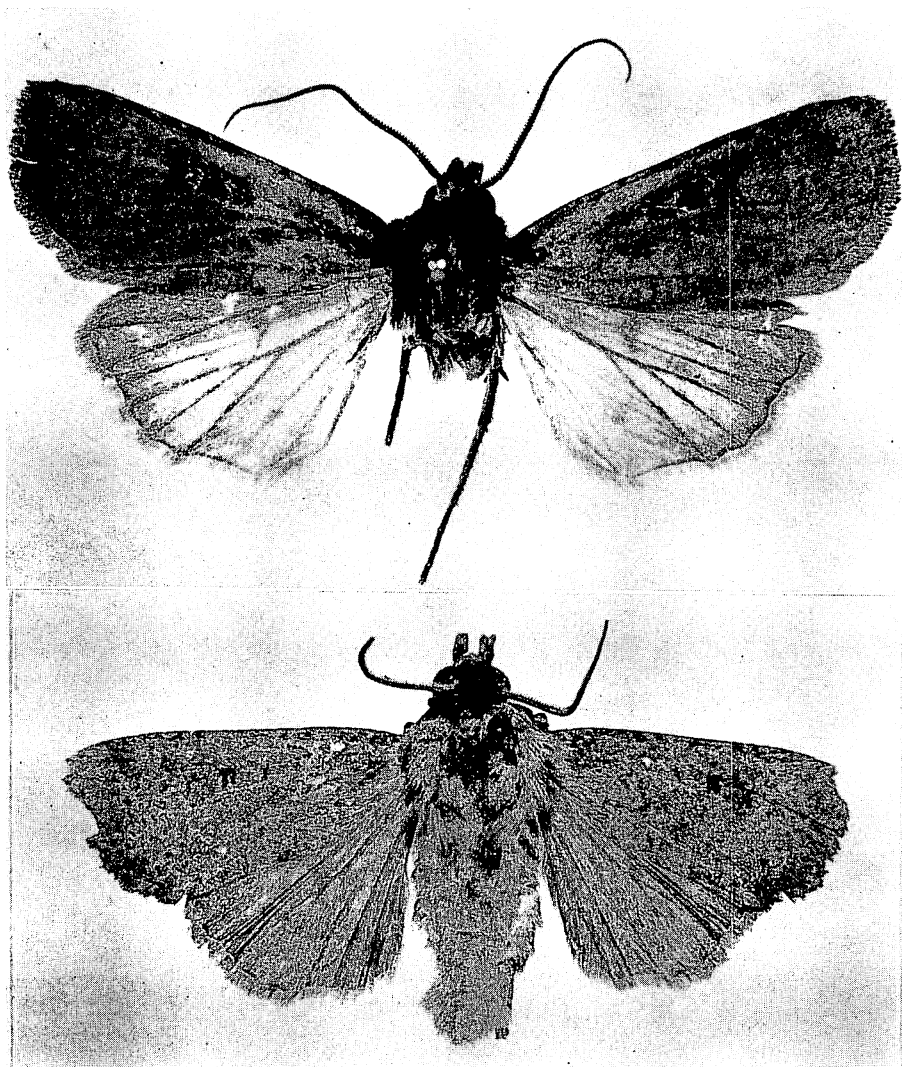


Figure 180—*Agrotis ceramophaea* Meyrick. Above: The male type; Kilauea, Hawaii; expanse, 39 mm. Below: The type of *stenospila* Meyrick (a color form and synonym of *ceramophaea* Meyrick); Kokee, Kauai; expanse, 39 mm.

Endemic. Kauai, Hawaii (type locality: Kilauea).

Hostplant: Unknown.

Meyrick's *stenospila* is a color form and a synonym of *ceramophaea*. The example in the British Museum is labeled as the type in error; it is the paratype, and the holotype is in the Experiment Station, H.S.P.A., Honolulu.

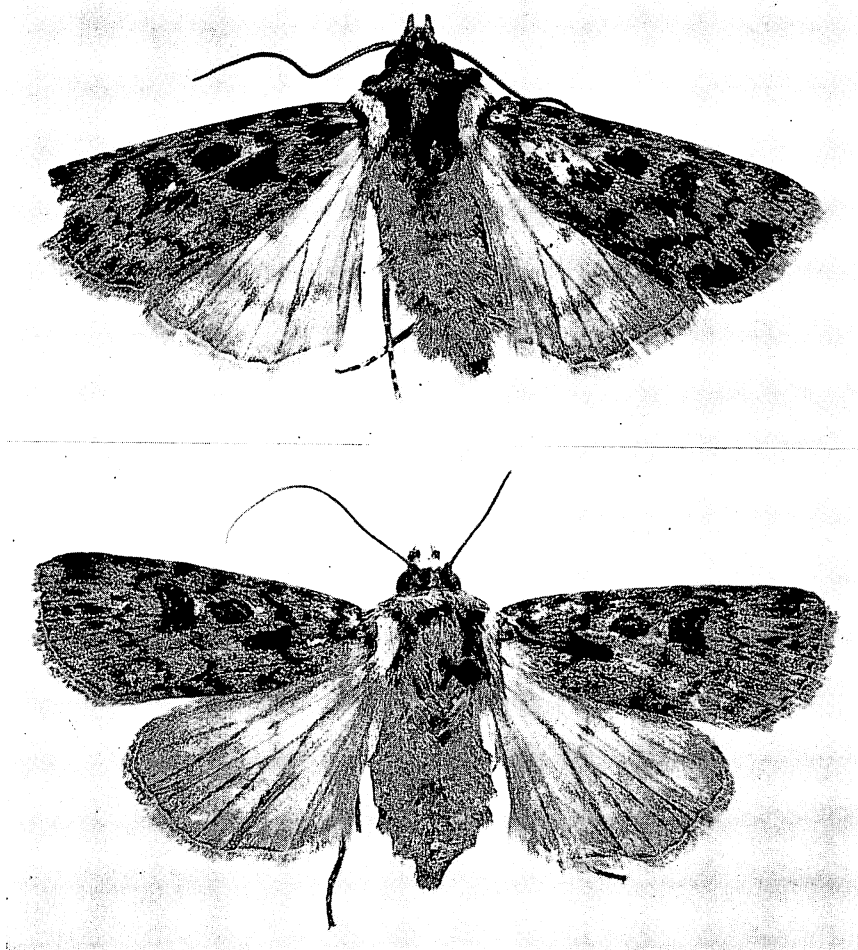


Figure 181—Above: *Agrotis charmocrila* (Meyrick), male type from Kaholuamano, Kauai; expanse, 35 mm. Below: A female from Kilauea, Hawaii, 4,000 feet.

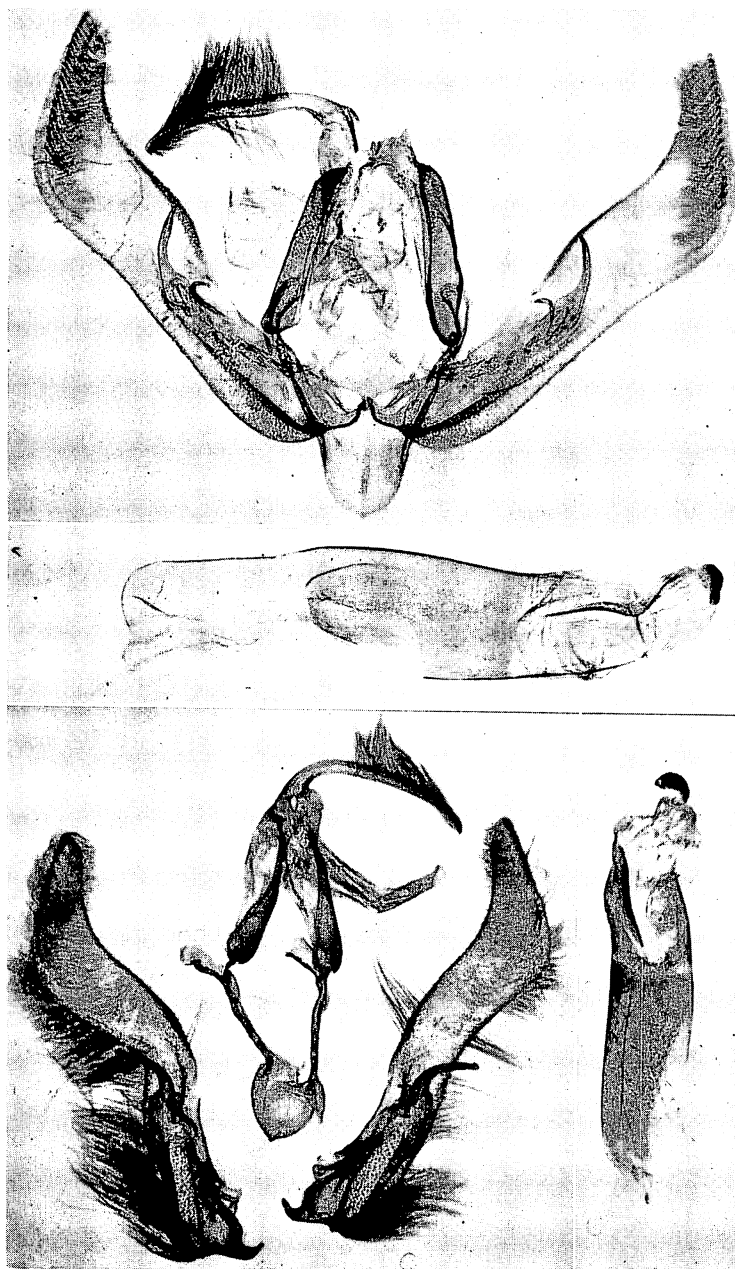


Figure 182—Male genitalia of *Agrotis*. Above: Paratype of *bryani* (Swezey); Nihoa. Below: A remounted, old, poorly preserved dissection of the type of *ceramophaea* Meyrick; Kilauea, Hawaii.



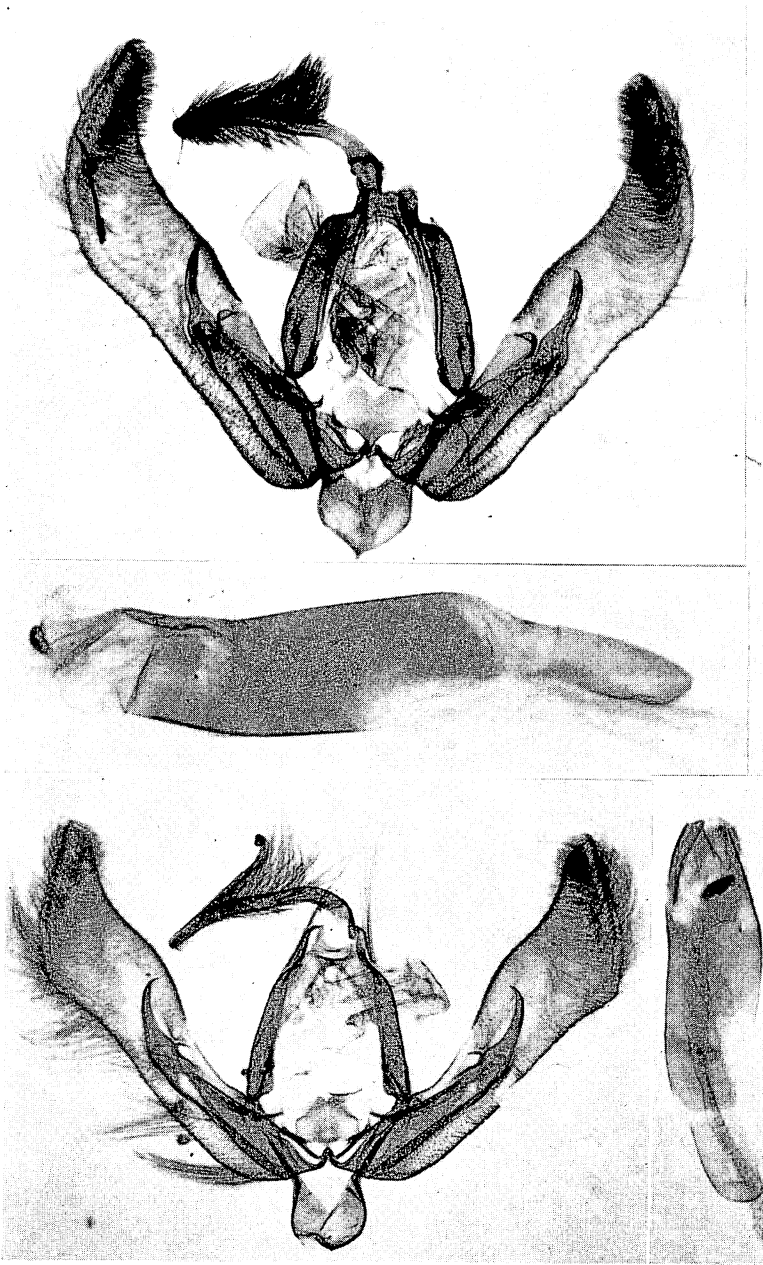


Figure 183—Male genitalia of *Agrotis*. Above: The type of *charmocrila* (Meyrick); Kaholua-mano, Kauai. Below: *cremata* (Butler); Maui.



Figure 184—Female genitalia of *Agrotis*. Left: *bryani* (Swezey), paratype; Nihoa. Right: *charmocrita* (Meyrick); Kilauea, Hawaii.

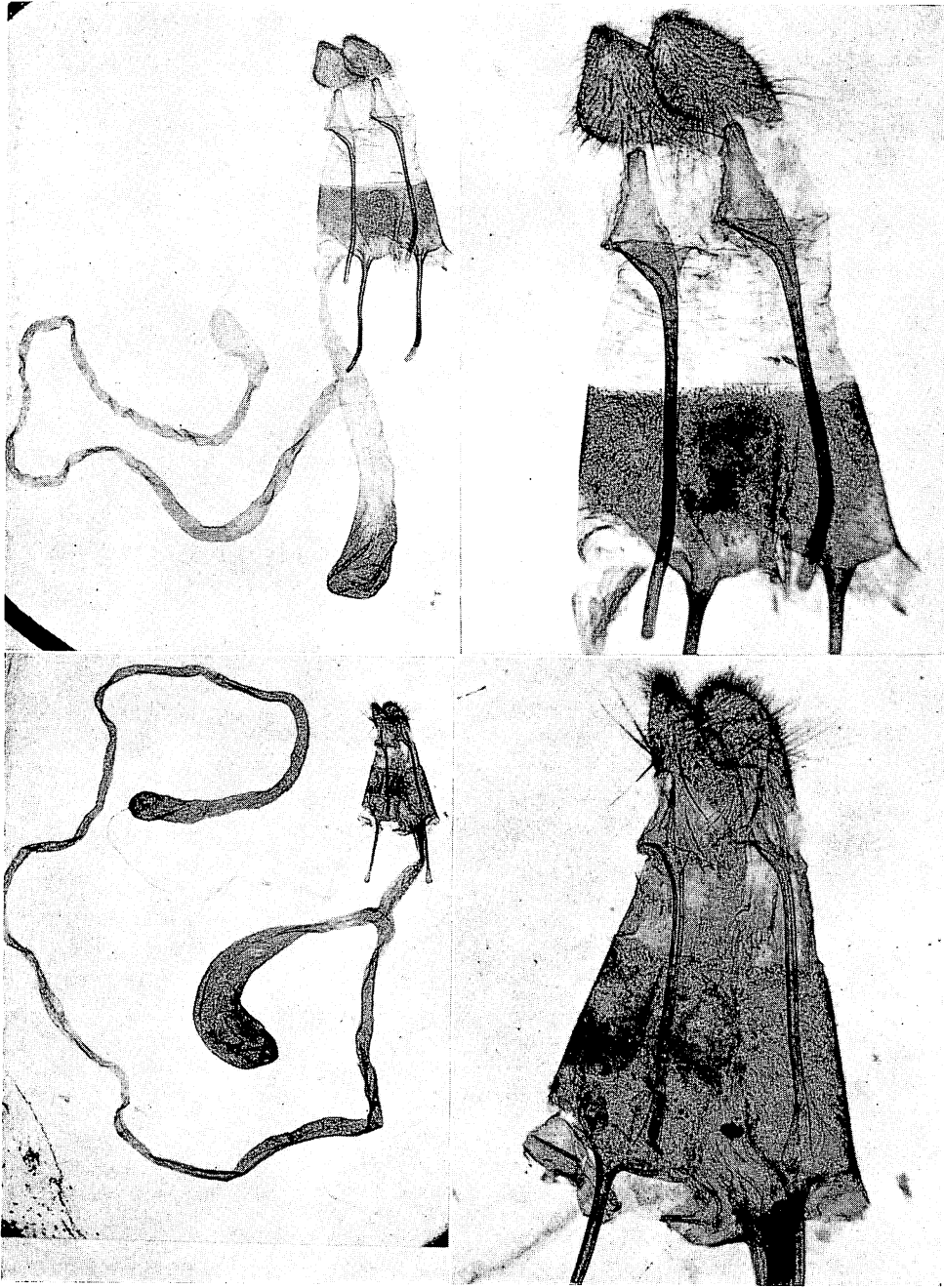


Figure 185—Female genitalia of *Agrotis*. Above: *cremata* (Butler), type; Oahu. Below: *crinigera* (Butler); Waialua, Oahu.

***Agrotis charmoerita*** (Meyrick), **new combination** (figs. 181, 183, 184).  
*Euxoa charmoerita* Meyrick, 1928:91.

Endemic. Kauai (type locality: Kaholuamano), Molokai.  
Hostplant: Unknown.

***Agrotis cremata*** (Butler) (figs. 183, 185, 186).

*Spaelotis cremata* Butler, 1880:8.

*Agrotis cremata* (Butler) Butler, 1881:321. Blackburn, 1882:56, larva. Meyrick, 1899:145.

*Euxoa cremata* (Butler) Hampson, 1903:191, pl. LXI, fig. 10. Warren, 1912:49, pl. 6e.

Endemic. Oahu, Maui (type locality: "Bred from a pupa found in a sandhill on Maui.").

Hostplant: Unknown.

Warren (1912:49) lists *laysanensis* (Rothschild) as a synonym of this species, but I cannot agree with his conclusion.

This species frequents the seaside.

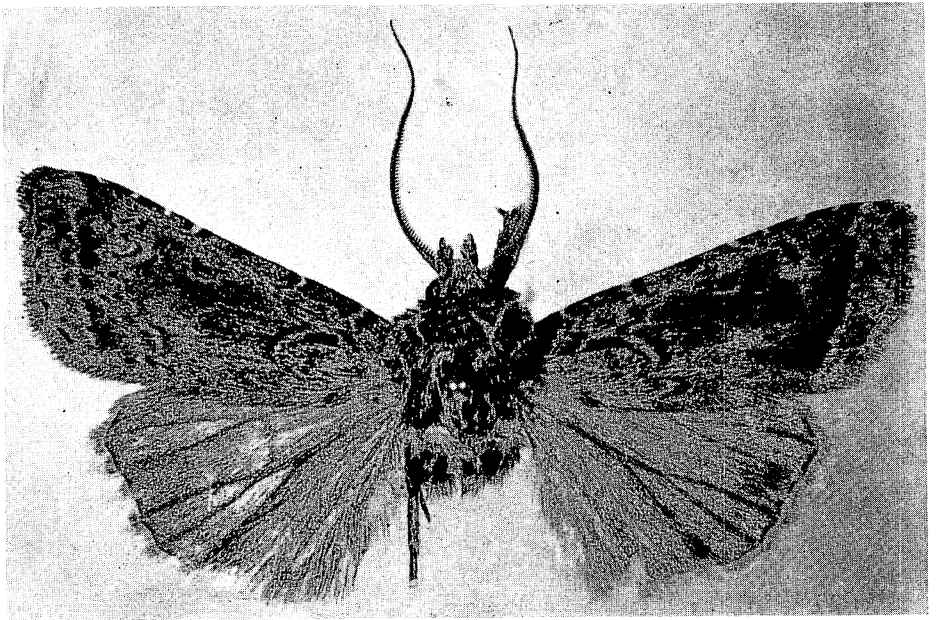


Figure 186—*Agrotis cremata* (Butler), male type; Maui; expanse, 42.5 mm.

**Agrotis crinigera** (Butler) (figs. 172, 185, 187, 189).*Spaelotis crinigera* Butler, 1881:321.*Agrotis crinigera* (Butler) Meyrick, 1889:148. Hampson, 1903:409, pl. LXX, fig. 17.*Rhyacia crinigera* (Butler) Warren, 1912:57, pl. 7f.

The larger native cutworm; Hawaiian name: "poko."

Endemic. Kauai, Oahu, Maui, Lanai, Hawaii (type locality: Kawaihae).

Hostplants: Various garden plants (especially legumes), beans, corn, cowpea, *Datura*, grasses, peas, *Portulaca*, *Sida*, sugarcane.Parasite: *Frontina archippivora* (Williston).

Predator: Golden plover.

Blackburn, quoted by Butler (1881:322), said: "This insect is extremely common all over the Hawaiian archipelago . . . I should say it is periodical in occurrence. I have taken it at all seasons of the year; but sometimes hardly a specimen is to be seen for months, then it swarms suddenly. At . . . Kawaihae, on the island of Hawaii, in February 1879, I observed it literally in thousands round a lighthouse. . . . The unset specimen (type of the male) was taken there; the largest specimen (type of the female) is from Maui, the other two from Honolulu. It does not usually occur much above sea-level. . . ."

There has been some mistake in labeling the male holotype, because it bears the following label: "Hawaii, Honolulu, Blackburn 81-7" and Blackburn's code for the island of Hawaii (a circle with a horizontal line drawn through it). As noted in the preceding quotation, Blackburn says that the male type was taken on Hawaii.

The egg-laying habits are unknown. From very small caterpillars which I have found and reared, I estimate that it takes the caterpillars from about one month to six weeks from hatching till they are full-grown. They are then 45 to 50 mm. in length and are more plump than other cutworms; in fact, this is the largest of our common cutworms.

The full-grown caterpillar . . . is quite similar to that of *Feltia dislocata*, but quite a bit larger; more blackish above, and paler below; the tubercles are not so conspicuous, the row below spiracles pale instead of black. The head lacks the black spot above eye cluster.

The pupa is formed in an earthen cocoon 30 mm. by 15 mm. It is 21 to 25 mm. long; light brown in color, darker on the back. The pupal period is 21 to 25 days, thus the life-cycle from egg to adult moth is probably a little more than two months, occupying a little longer period than the other common species . . . (Swezey, 1909: 18).

**Agrotis dislocata** (Walker) (figs. 173, 188, 189, 190).*Leucania dislocata* Walker, 1856:112. Butler, 1878:185.*Agrotis dislocata* (Walker) Meyrick, 1899:146; 1904:346.*Feltia dislocata* (Walker) Hampson, 1903:351, pl. LXVIII, fig. 12.*Euxoa dislocata* (Walker) Warren, 1912:51, pl. 6h.*Feltia lookii* Swezey, 1947:103. **New synonym.**

The lesser native cutworm.

Endemic. Niihau, Kauai, Oahu (type locality: presumably Honolulu; "Presented by the Lords of the Admiralty"), Molokai, Maui, Lanai, Hawaii, Laysan.

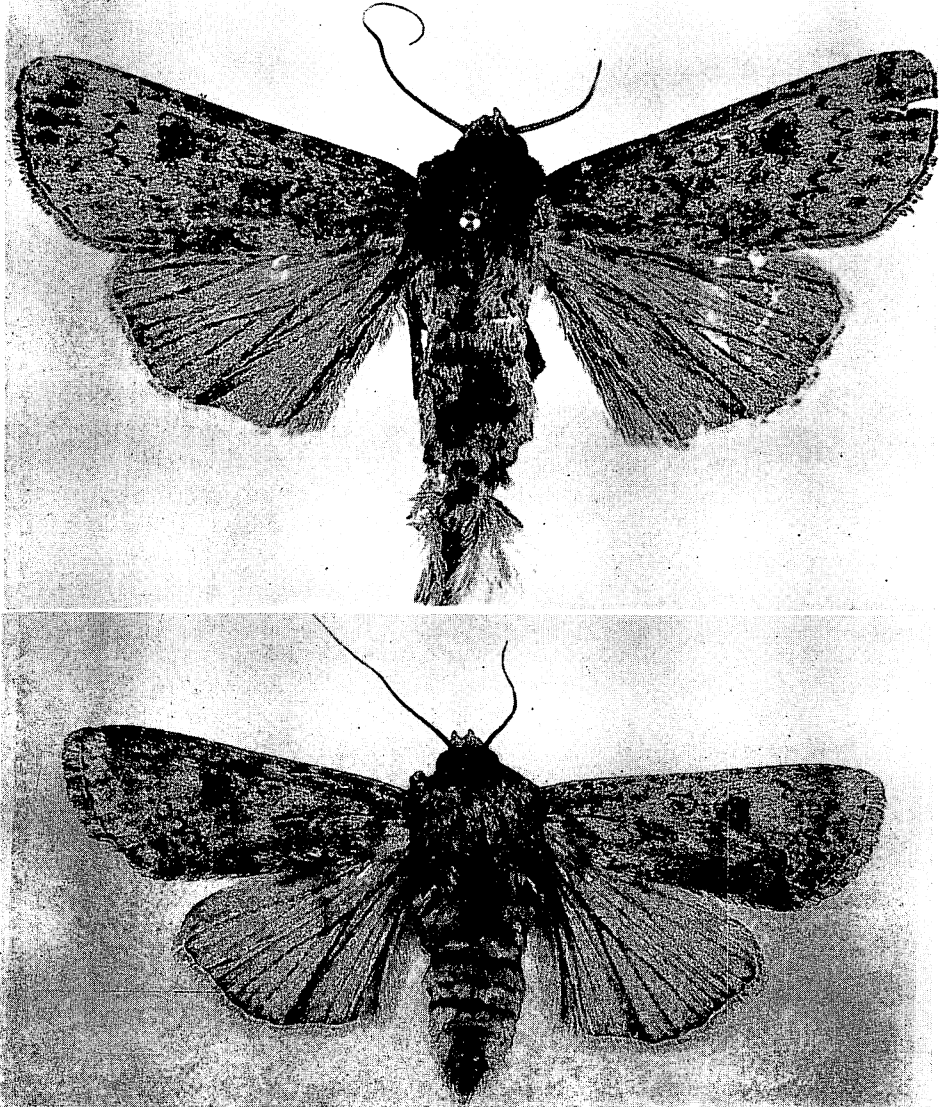


Figure 187—A pair of *Agrotis crinigera* (Butler). Upper figure is the male type; expanse, 48 mm. It bears the labels "Hawaii, Honolulu, Blackburn 81-7" and Blackburn's code sign (see vol. 6 of this series for explanation) for the Island of Hawaii, and the word Honolulu was placed on the label in error. The type came from Kawaihae, Hawaii. The lower figure is of a female from Diamond Head, Honolulu; expanse, 49 mm.

Hostplants: Various garden crops, *Chenopodium*, grasses, sugarcane.

Parasites: *Chaetogaedia monticola* (Bigot), *Frontina archippiwora* (Williston).

Predator: "A favourite food of the golden plover, which catches the moths, as well as their caterpillars." (Perkins, 1913:cxlvii).

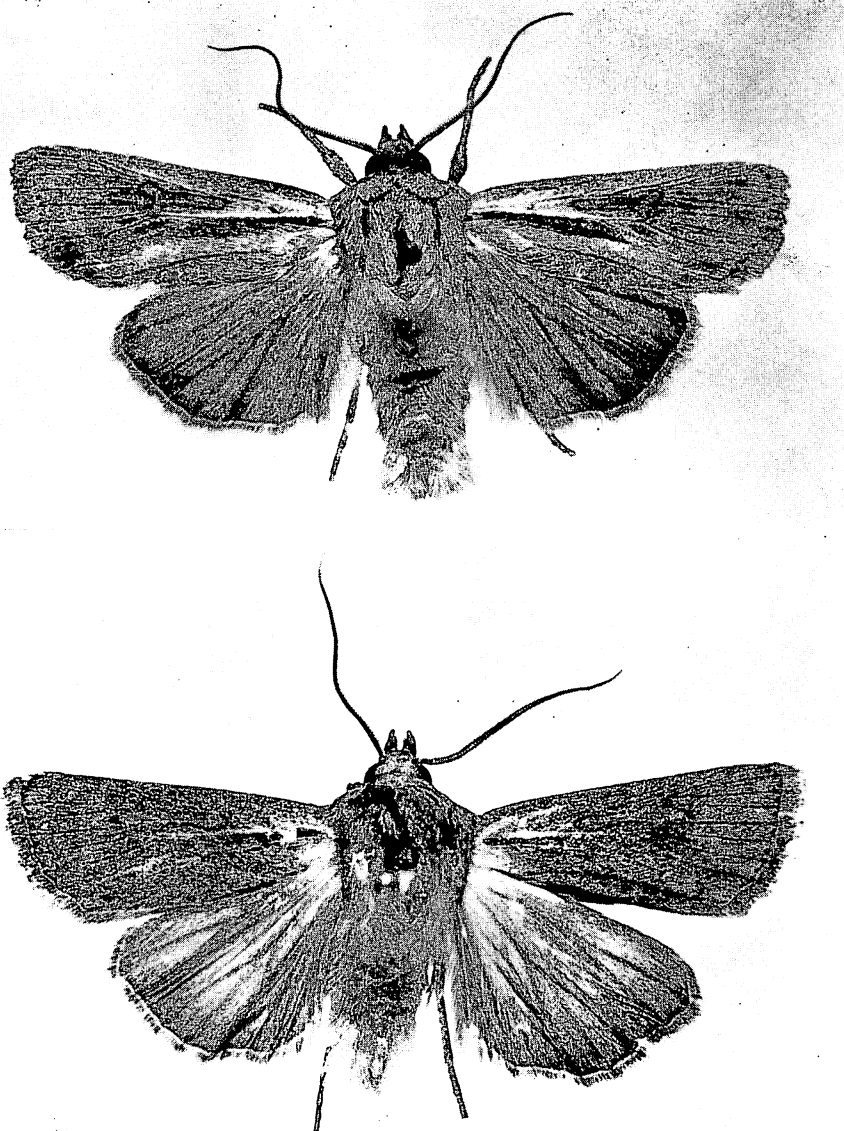


Figure 188—*Agrotis dislocata* (Walker). The upper figure is of a male from Paia, Maui; expanse, 35 mm. The lower figure is a male from Swezey's series which he named *lookii*; Saddle Road, Hawaii; expanse, 35 mm. It is here considered only one of the color forms of the variable *dislocata*.



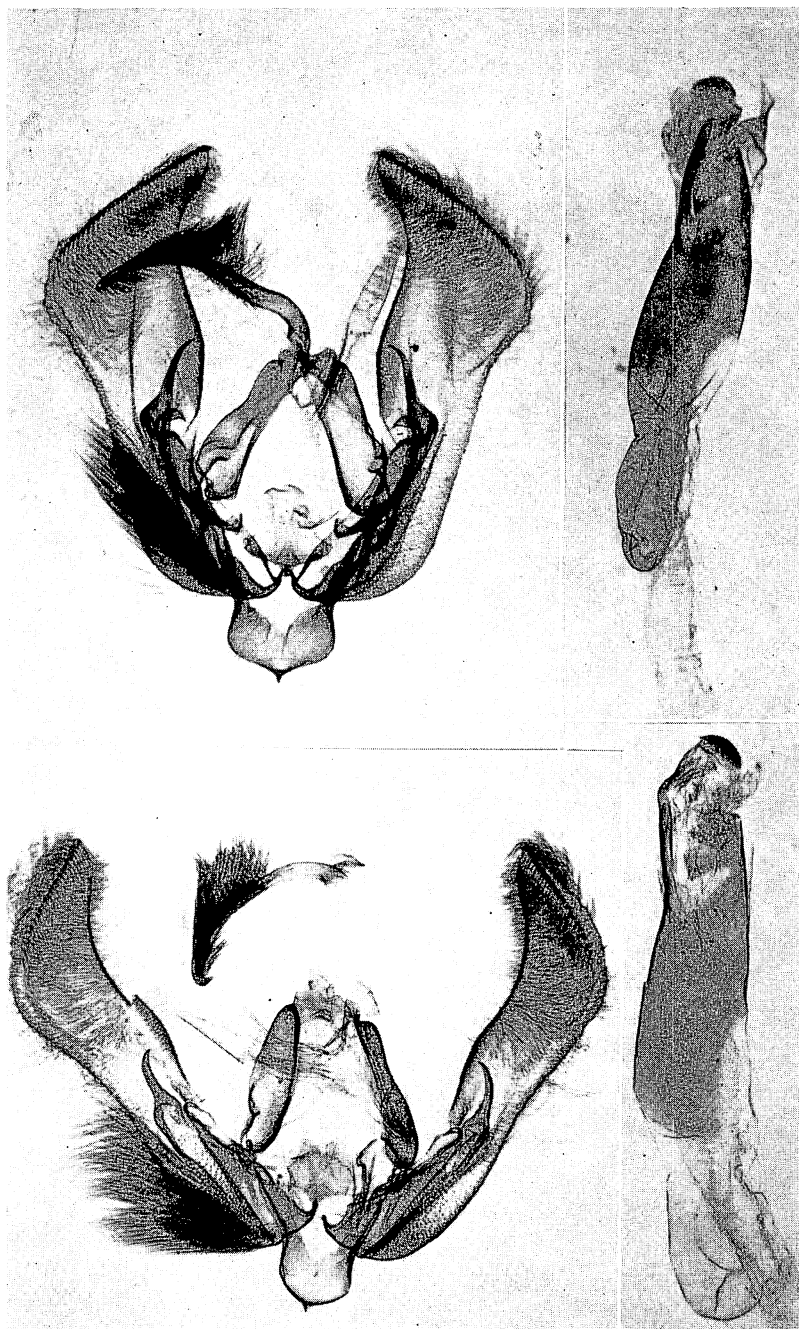


Figure 189—Male genitalia of *Agrotis*. Above: *crinigera* (Butler), Oahu. Below: *dislocata* (Walker); Oahu.



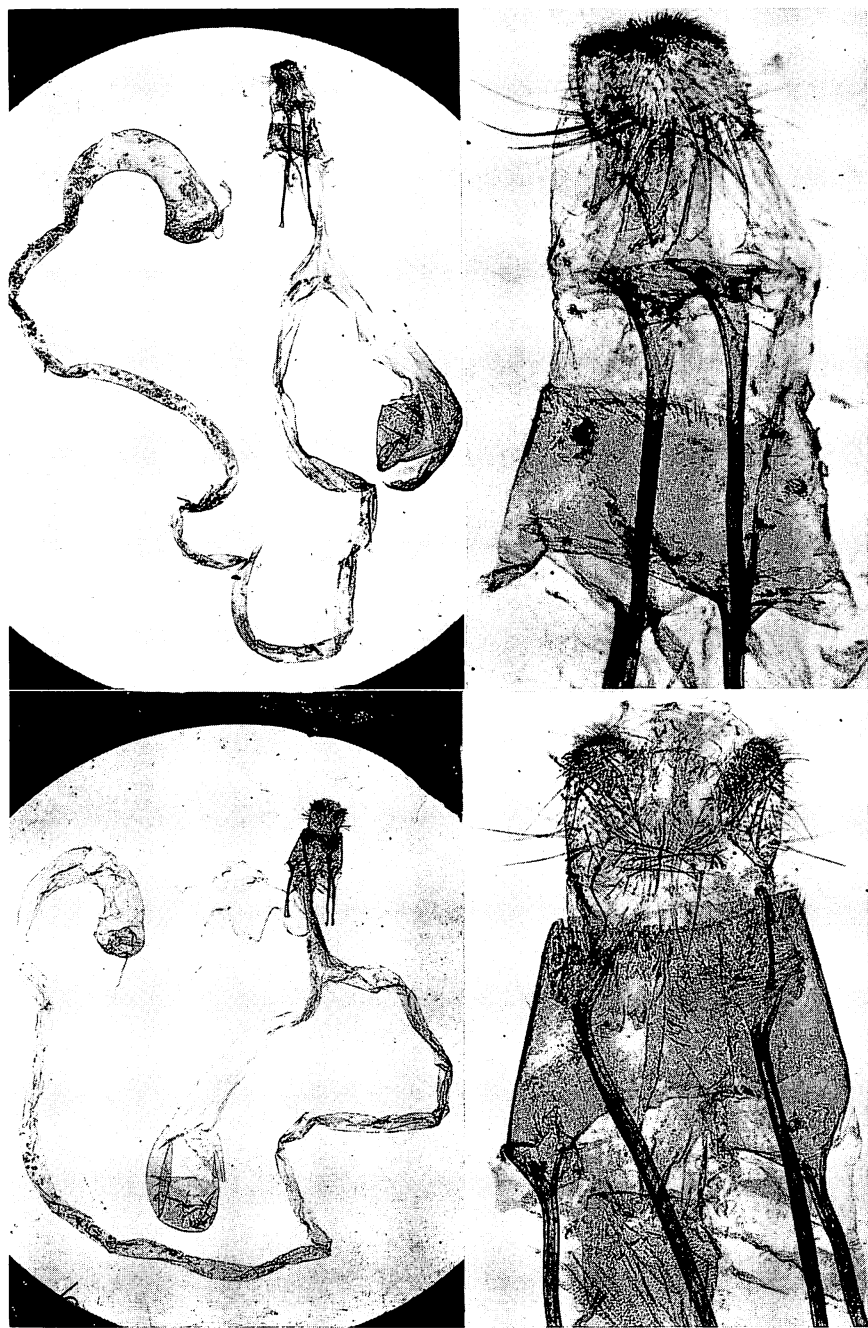


Figure 190—Female genitalia of *Agrotis*. Above: *dislocata* (Walker); an example from the Beechey Expedition. Below: *epicremna* Meyrick; Haleakala, Maui, 9,000 feet.

This is a native cutworm and often becomes a bad pest in sugarcane, as well as in gardens and also on other crops. From my observations, it is more injurious to garden crops than to cane; but it is often reported numerous locally in cane fields. I have often taken specimens in cane fields in company with the army worm (*Cirphis unipuncta*). They are slightly larger than the latter, and have more strictly the cutworm habit of feeding; that is, of hiding during the day in the soil or under trash and rubbish on the surface of the soil, and feeding at night on the lower leaves of the plant.

The eggs . . . are laid at the base of plants, or even scattered on the soil, sometimes single, some-

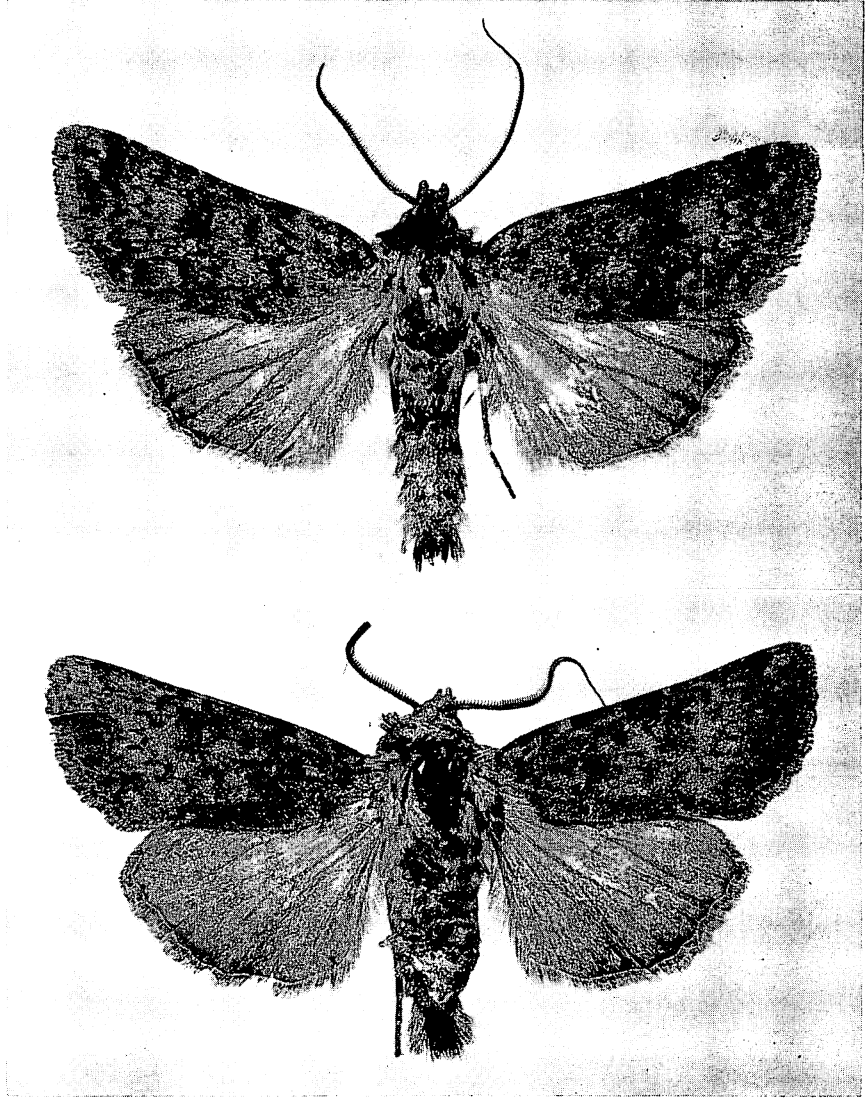


Figure 191—Above: *Agrotis epicremna* Meyrick, male type; Haleakala, Maui, 10,000 feet; expanse, 45 mm.; collected by Perkins. Below: Another male taken on the summit of Haleakala by Swezey; expanse, 46 mm.

times two or three adhering together, and sometimes as many as a dozen in a bunch together or even a hundred or more in an irregular one-layered [one-layer?] mass. They are of a yellowish white color, nearly spherical, 0.8 mm. in diameter, minutely reticulated at upper pole and radiately ridged from it down the sides.

They hatch in a week or ten days. The caterpillars molt five times at intervals of four to six days, attaining their full-growth (36–40 mm.) in three to five weeks (sometimes much longer than this in hot, dry seasons).

The full-grown caterpillar . . . is of a dirty brownish color, with a broad lighter brown stripe on the back; under side dirty whitish. Tubercles black, a row of them on each side of the dorsal lighter stripe, are larger and more conspicuous than the rest. Hairs short, black. Spiracles oval, black, head rather small proportionately, brown with blackish spot above each eye cluster, and two black bars in front converging above. The dorsal part of first segment behind head very dark brown. The full-grown caterpillar forms an earthen cell in the ground a few inches below the surface. After four to six days it transforms to the pupa which is similar in form to the pupa of *Cirphis unipuncta*, about 17 mm. long, and of a pale yellowish brown color. The moth appears in 15 to 20 days, which makes a period of about two months from the time the eggs were laid. (Swezey, 1909:16–17.)

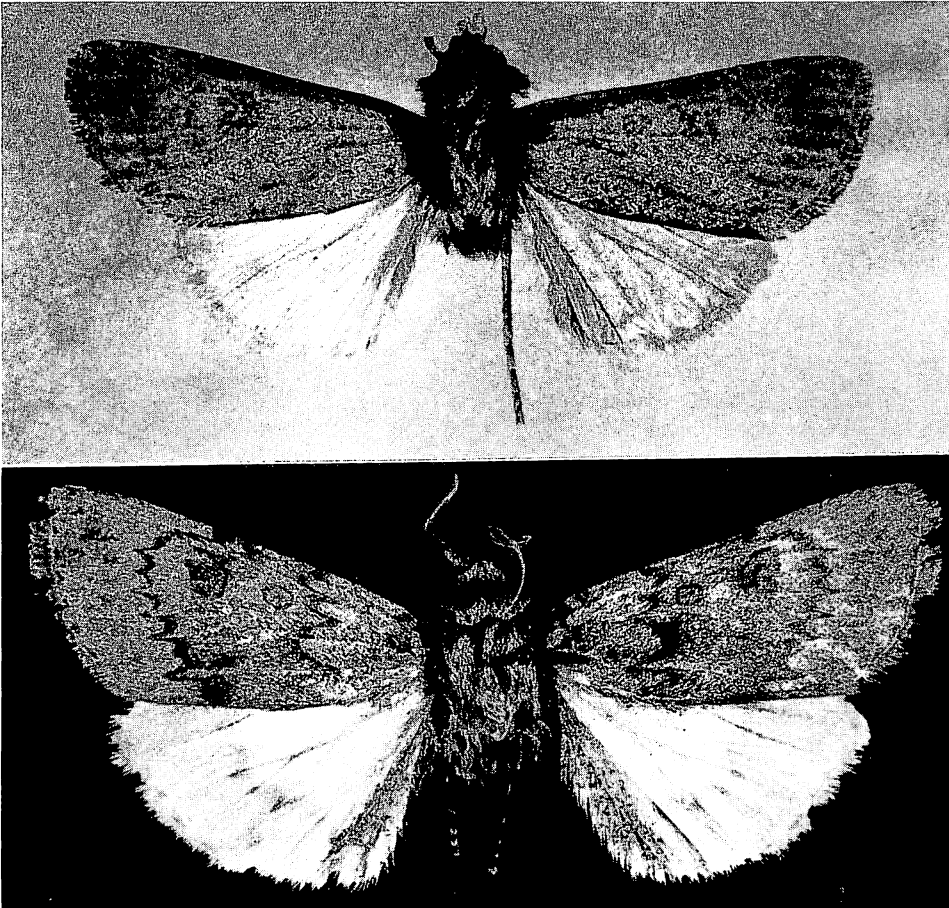


Figure 192—Above: *Agrotis evanescens* (Rothschild), male type from Laysan; expanse, 38 mm. Below: *fasciata* (Rothschild), male type from Midway; expanse, 47 mm. These examples are figured by Rothschild, 1895, pl. 10.

I have been unable to find any differences between the genitalia of the male or female of the form Dr. Swezey called *lookii* to separate it from typical *dislocata*, and I conclude that, at most, it is only a color form of *dislocata*. Dr. Swezey thought that the larvae of *lookii* lived exposed upon the *Chenopodium* plants instead of hiding beneath the plants during the day and foraging at night as typical *dislocata* is known to do. I believe, however, that an error in observation has been made and that the exposed larvae Swezey observed belong to another

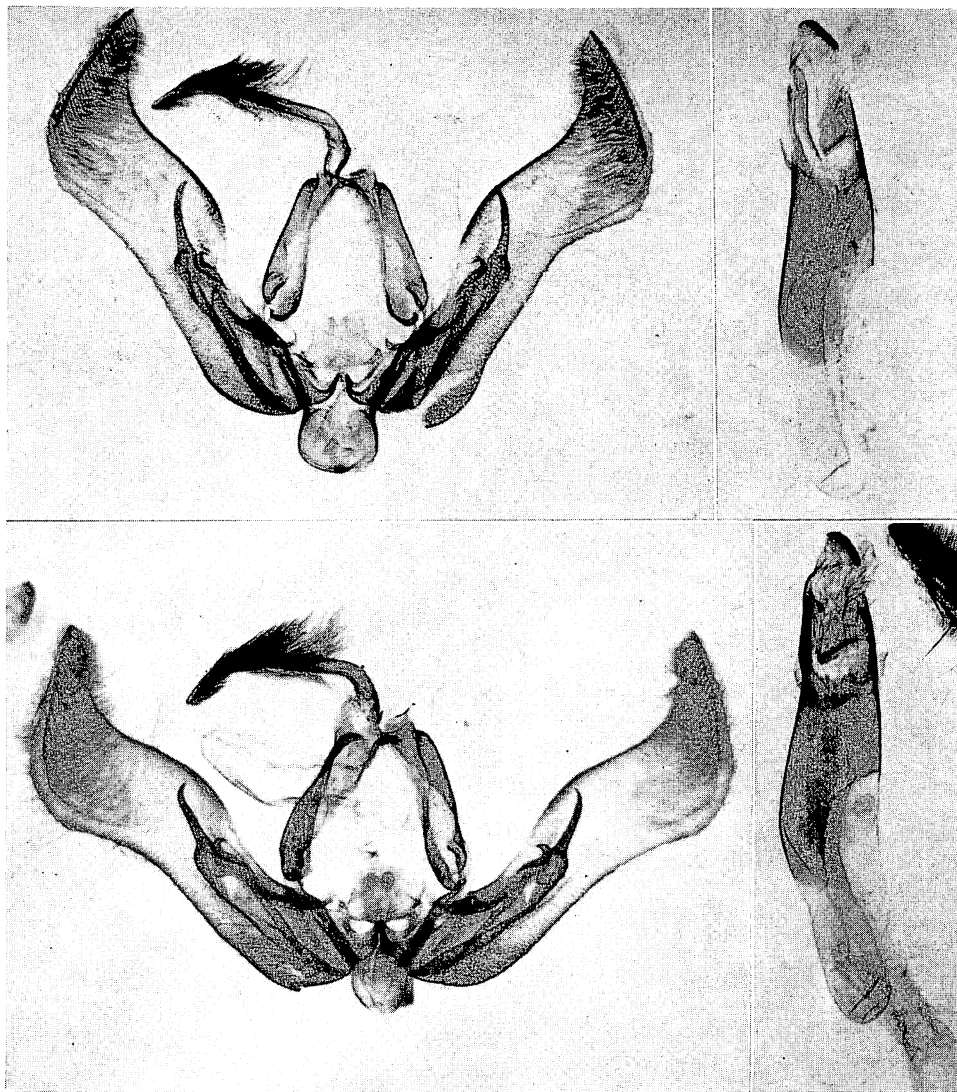


Figure 193—Male genitalia of *Agrotis evanescens* (Rothschild), the type from Laysan. Below: the lectotype of the synonym *eremioides* Meyrick.

moth, possibly *Peridroma coniotis*. Typical *dislocata* were reared from pupae taken from the soil beneath the same plants where *lookii* was found. In typical *dislocata*, the combined reniform and orbicular spots expand abruptly just beyond the middle and are dagger-shaped. On the color form called *lookii*, however, this combined spot is only slightly widened distad of middle.

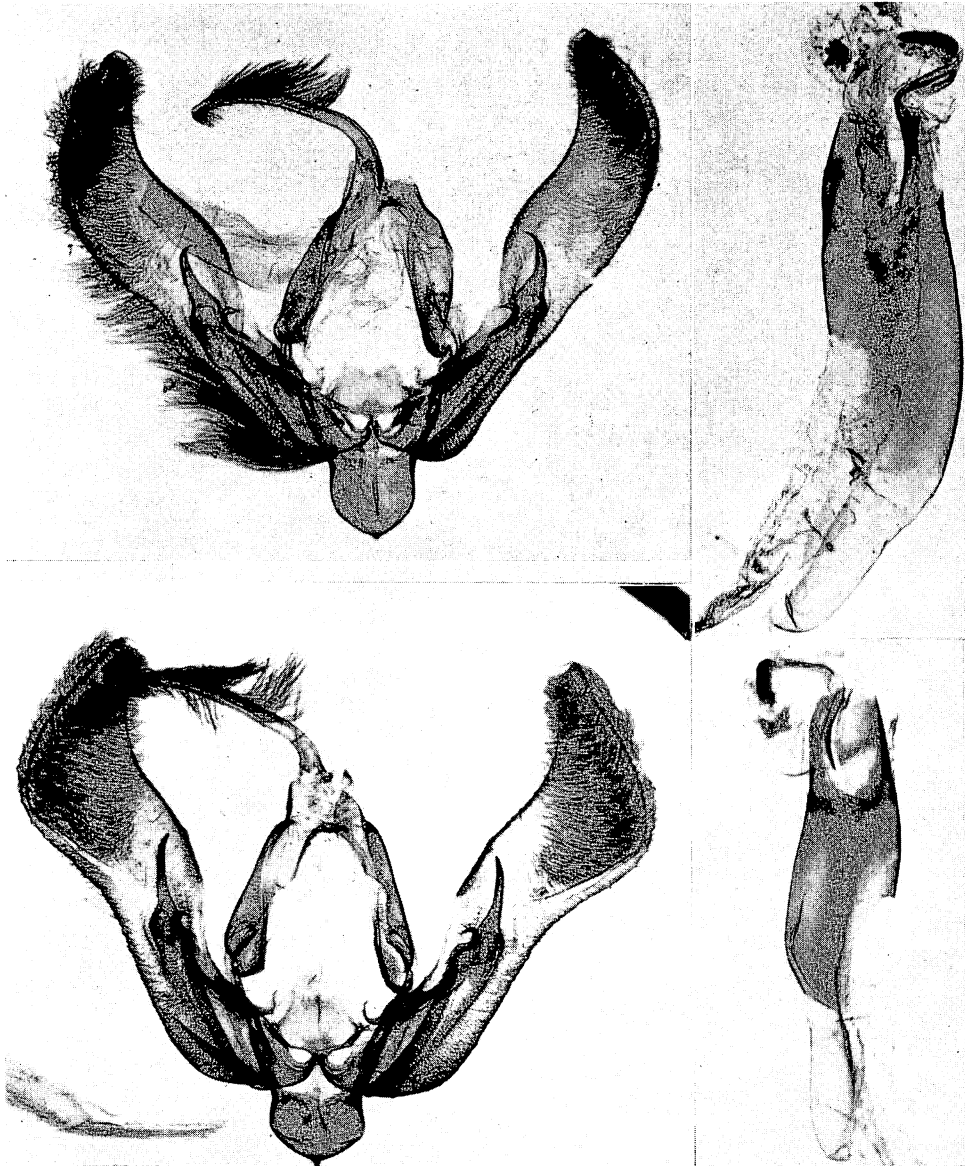


Figure 194—Male genitalia of *Agrotis*. Above: *epicremna* Meyrick; Haleakala, Maui, 9,000 feet. Below: The type of *fasciata* (Rothschild); Midway Island.

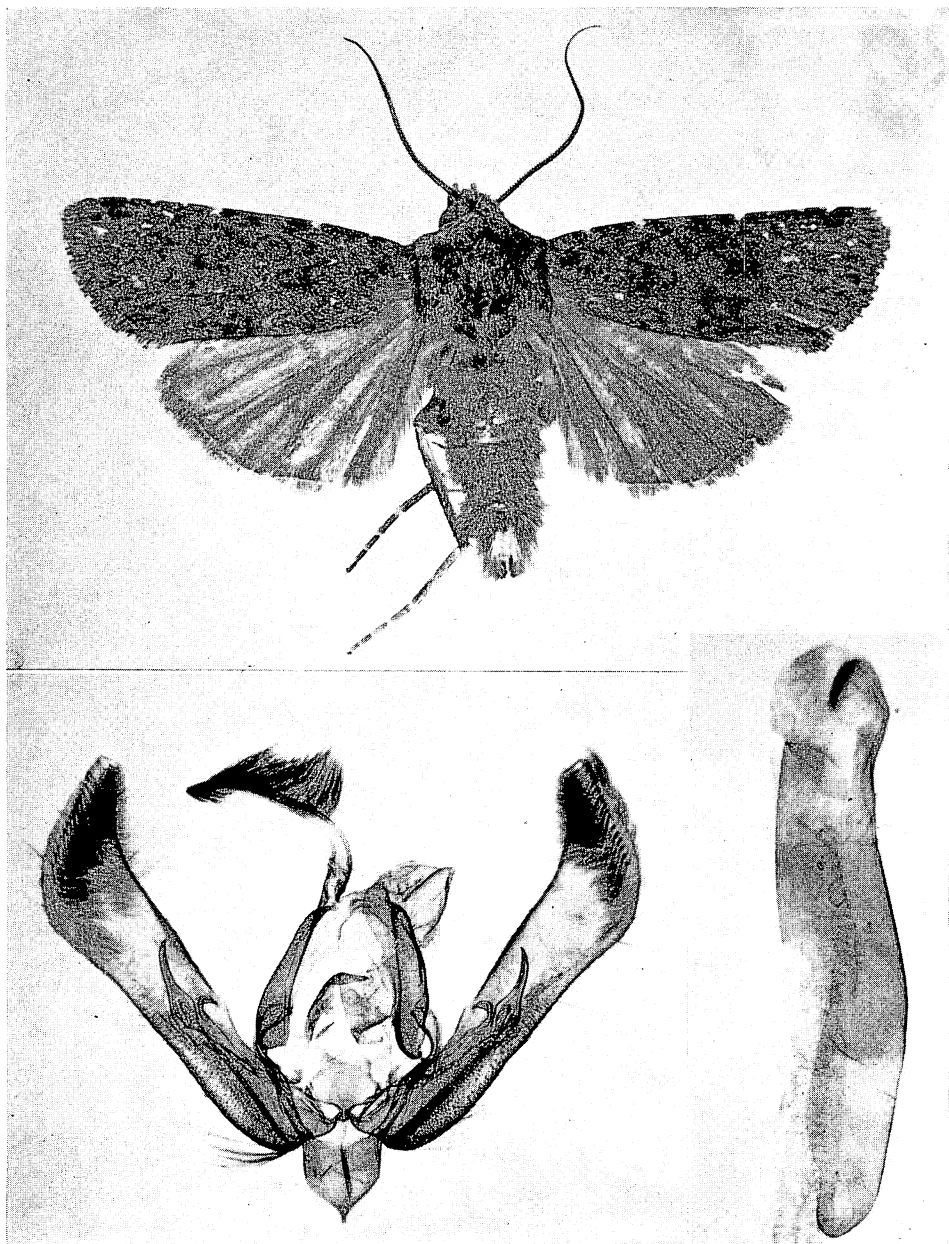


Figure 195—*Agrotis giffardi* (Swezey), male type; dry forest, Kilauea, Hawaii, 4,000 feet; expanse, 42 mm.; and genitalia.

**Agrotis epicremna** Meyrick (figs. 172, 190, 191, 194).*Agrotis epicremna* Meyrick, 1899:149, pl. 4, fig. 9.*Euxoa epicremna* (Meyrick) Hampson, 1903:187, pl. LX, fig. 29. Warren, 1912:49, pl. 6f.

Endemic. Maui (type locality: Haleakala, 10,000 feet).

Hostplant: *Argyroxiphium* (silversword)?

Caterpillars presumed to be of this species have been found beneath silversword plants in the crater of Haleakala.

**Agrotis evanescens** (Rothschild), **new combination** (figs. 172, 192, 193, 199).*Peridroma evanescens* Rothschild, 1894:539, pl. 10, fig. 9 (in vol. 2 for 1895).*Agrotis eremioides* (Meyrick) Hampson, 1903:227, pl. LXII, fig. 28. Synonymy by Warren, 1912:50, pl. 6g.

Endemic. Laysan (type locality).

Hostplant: Unknown.

Meyrick's *eremioides* was described from a series of 26 specimens collected by Shauinsland, and the type is in Städtisches Museum für Naturkunde, Bremen. The type of *evanescens* is in the British Museum.**Agrotis fasciata** (Rothschild), **new combination** (figs. 192, 194).*Peridroma fasciata* Rothschild, 1894:539; pl. 10, fig. 8 (in vol. 2 for 1895).

Endemic. Midway Island (type locality).

Hostplant: Unknown.

Warren (1912:50) lists this species as a "form" of *lucicolens* (which is now merged with *photophila*), but I do not agree.**Agrotis giffardi** (Swezey), **new combination** (fig. 195).*Euxoa giffardi* Swezey, 1932:198, pl. 13, fig. 2.

Endemic. Hawaii (type locality: dry forest at Kilauea).

Hostplant: Unknown.

This is extremely close to *mesotoxa* and may be a synonym. Additional material must be obtained for study before the question can be answered. Only one male is known, and *mesotoxa* is known from only two females.**Agrotis hephaestaea** Meyrick (figs. 196, 197, 198, 199).*Agrotis hephaestaea* Meyrick, 1899:346.*Euxoa hephaestaea* (Meyrick), of authors.*Euxoa diplosticta* Hampson, 1909:368 (type from Waialua, Oahu). Synonymy by Swezey, 1944:135.*Euxoa wikstroemiae* Swezey, 1920:376; 1954:224. Synonymy by Swezey, 1944:135.



Endemic: Kauai, Oahu (type locality: northwest Koolau Mountains), Molokai.  
Hostplant: *Wikstroemia*.

Swezey (1920:377-378) gave the following notes on the immature stages:

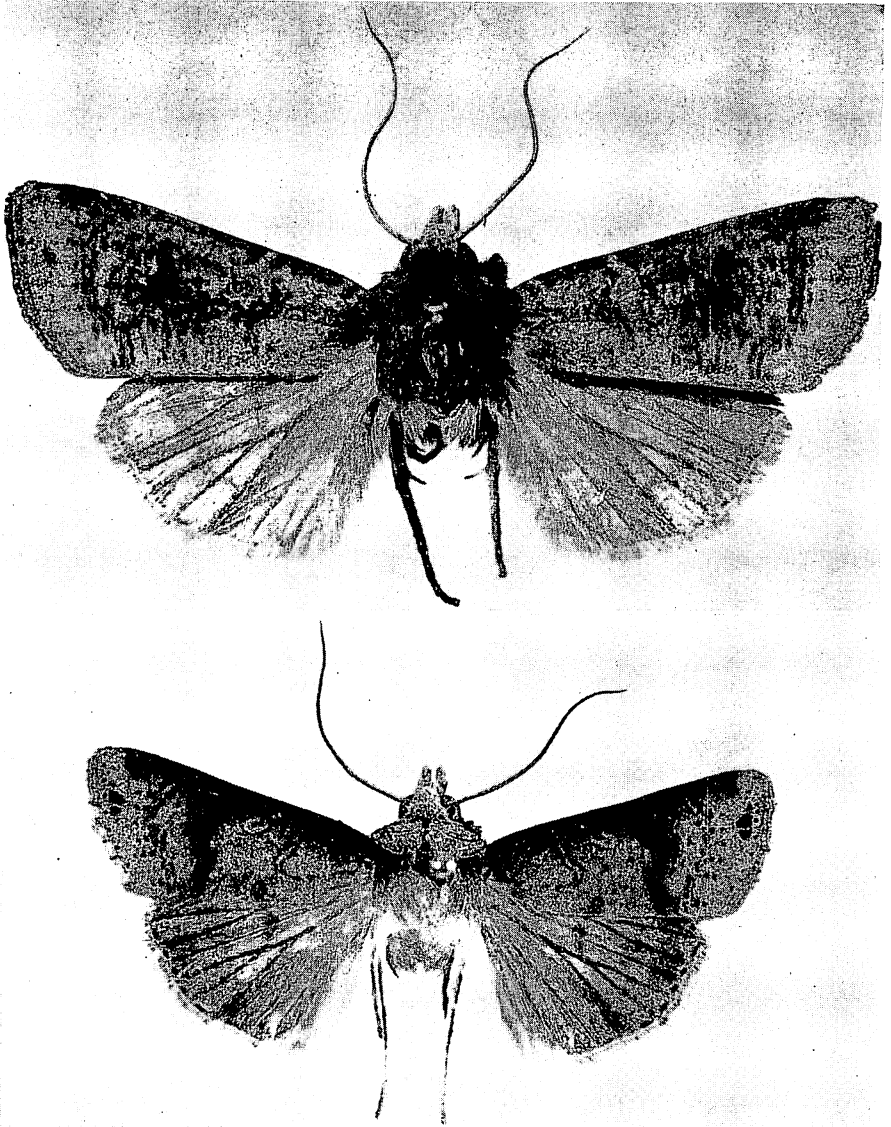


Figure 196—*Agrotis hephaestaea* Meyrick. Above: Male type; northwest Koolau Mts., Oahu; expanse, 42 mm. Below: The male type of the synonym *diplosticta* Hampson; Waialua, Oahu; expanse, 35.5 mm. (This print is too dark.)



Caterpillar. The full-grown caterpillar was 40 mm. in length; nearly uniformly dark fuscous, minutely spotted with paler, whitish on ventral surface; head light ferruginous; cervical shield black with a broad yellow discal patch widest posteriorly, a median white line which extends indistinctly onto the two following segments; setae very short, pale, each in a black dot; anal shield black with several yellow spots; spiracles oval, entirely black.

Pupa. 20 mm. long; yellowish brown, infuscated on dorsum of metathorax and abdomen; a dorsal transverse band of small pits near anterior margin of 5th, 6th, and 7th abdominal segments; wing-sheaths, antennae-sheaths and posterior leg-sheaths extend to apex of 4th abdominal segment; cremaster with two short diverging spines, thick at base, dark reddish, apical half whitish.

The caterpillars are found on their food-plant in the daytime, a different habit from the other species so far as known. Having a tree for a food-plant is also an unusual habit for the moths of this kind in Hawaii.

Pupation takes place in the soil.

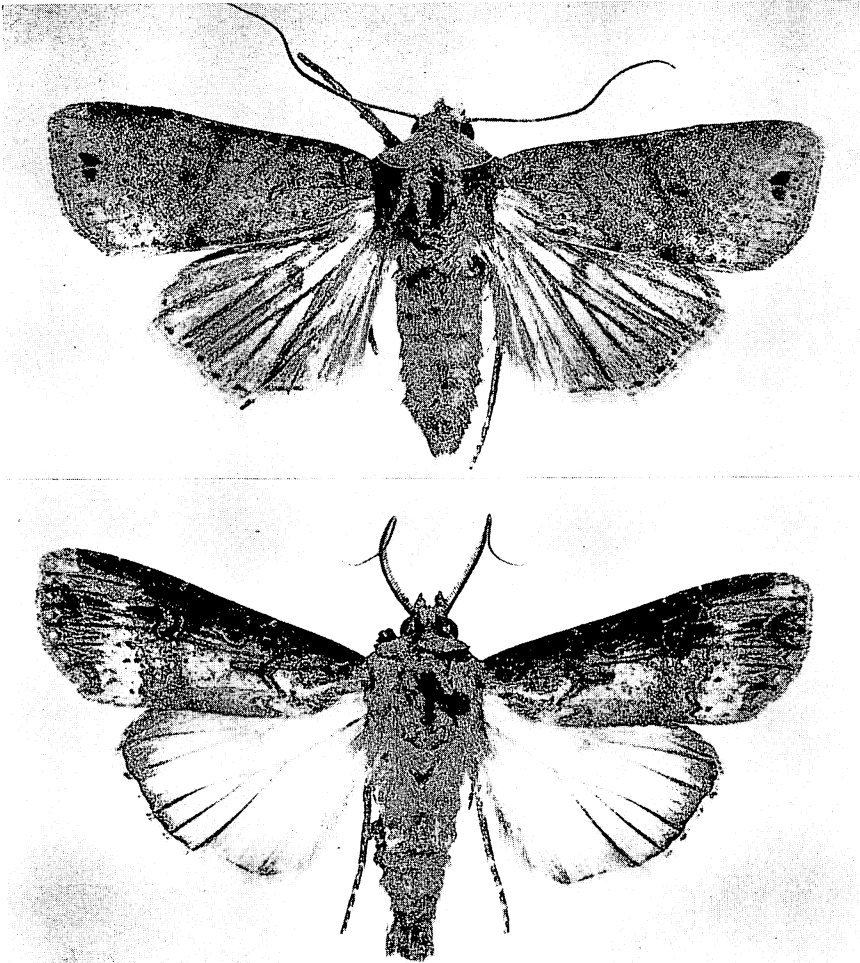


Figure 197—Above: *Agrotis hephaestaea* Meyrick, from a paratype of the synonym *wikstroemiae* Swezey; Waimea, Kauai; expanse, 40 mm. Below: *ipsilon* (Hufnagel); Opaepala, Oahu; expanse, 47 mm.

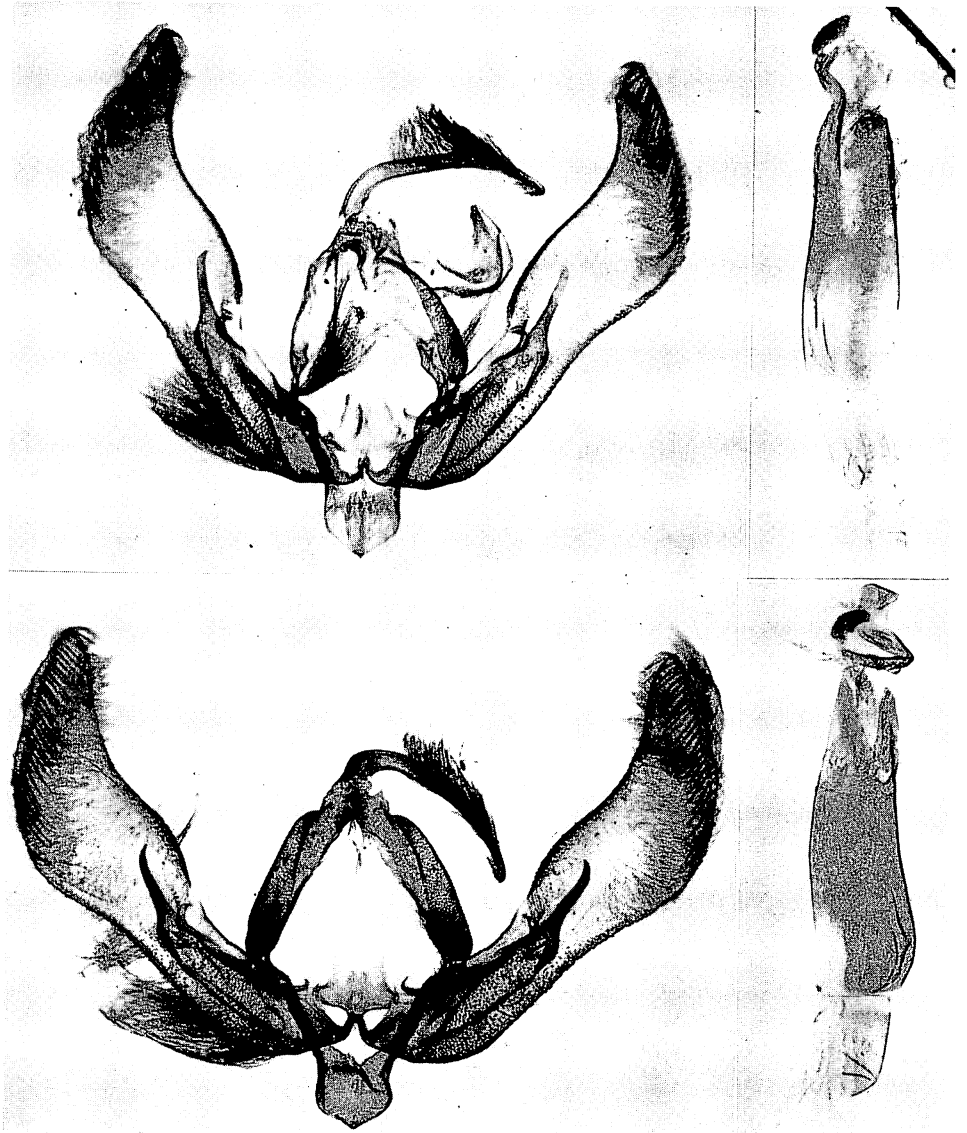


Figure 198—Male genitalia of *Agrotis hephaestaea* Meyrick. Above: The type from the north-western Koolau Mts., Oahu. Below: The type of the synonym *diplosticta* Hampson; Waialua, Oahu.

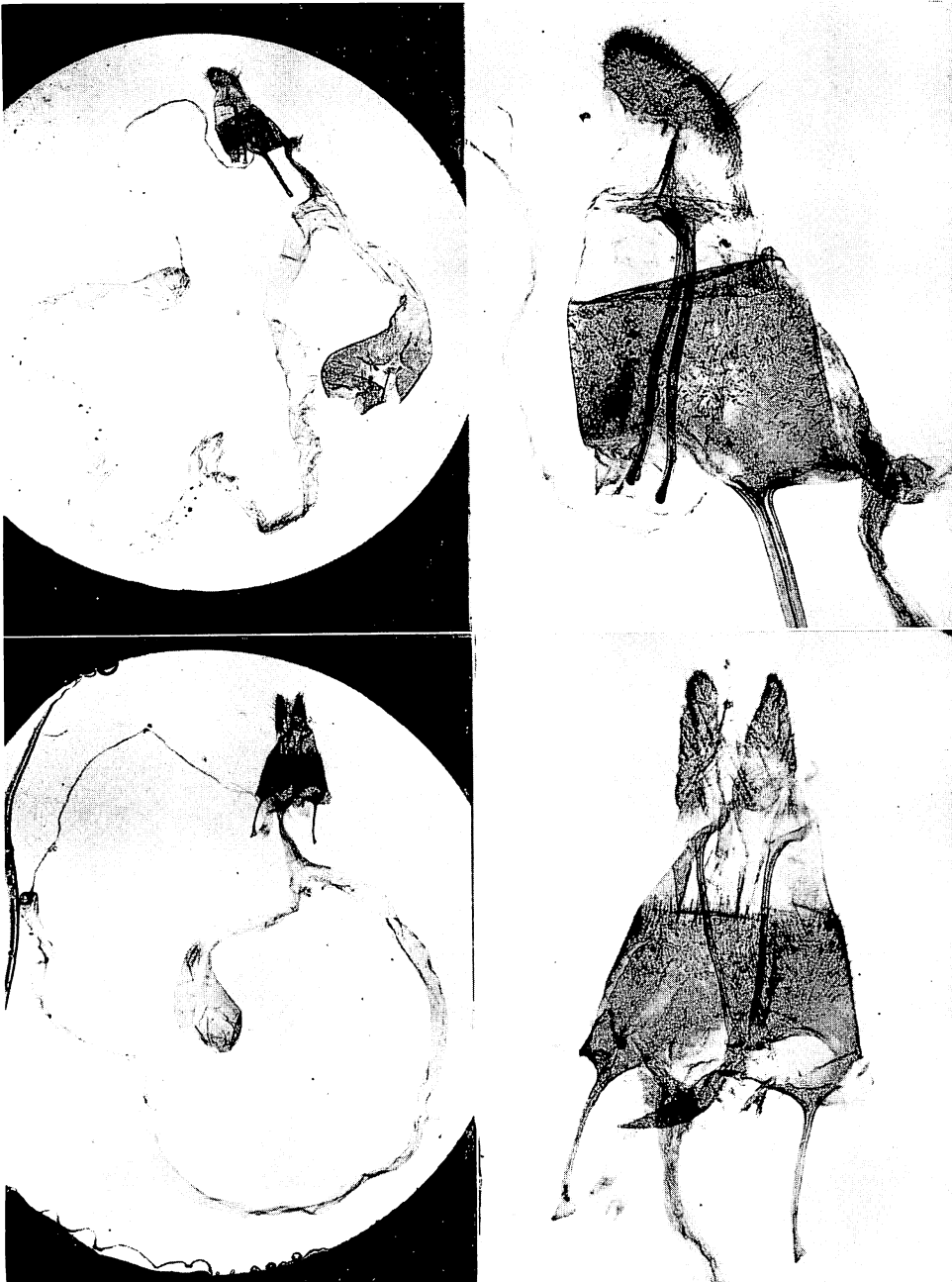


Figure 199—Female genitalia of *Agrotis*. Above: *evanescens* (Rothschild), from an example of the synonym *eremioides* Meyrick; Laysan. Below: *hephaestaea* Meyrick; northwestern Koolau Mts., Oahu.

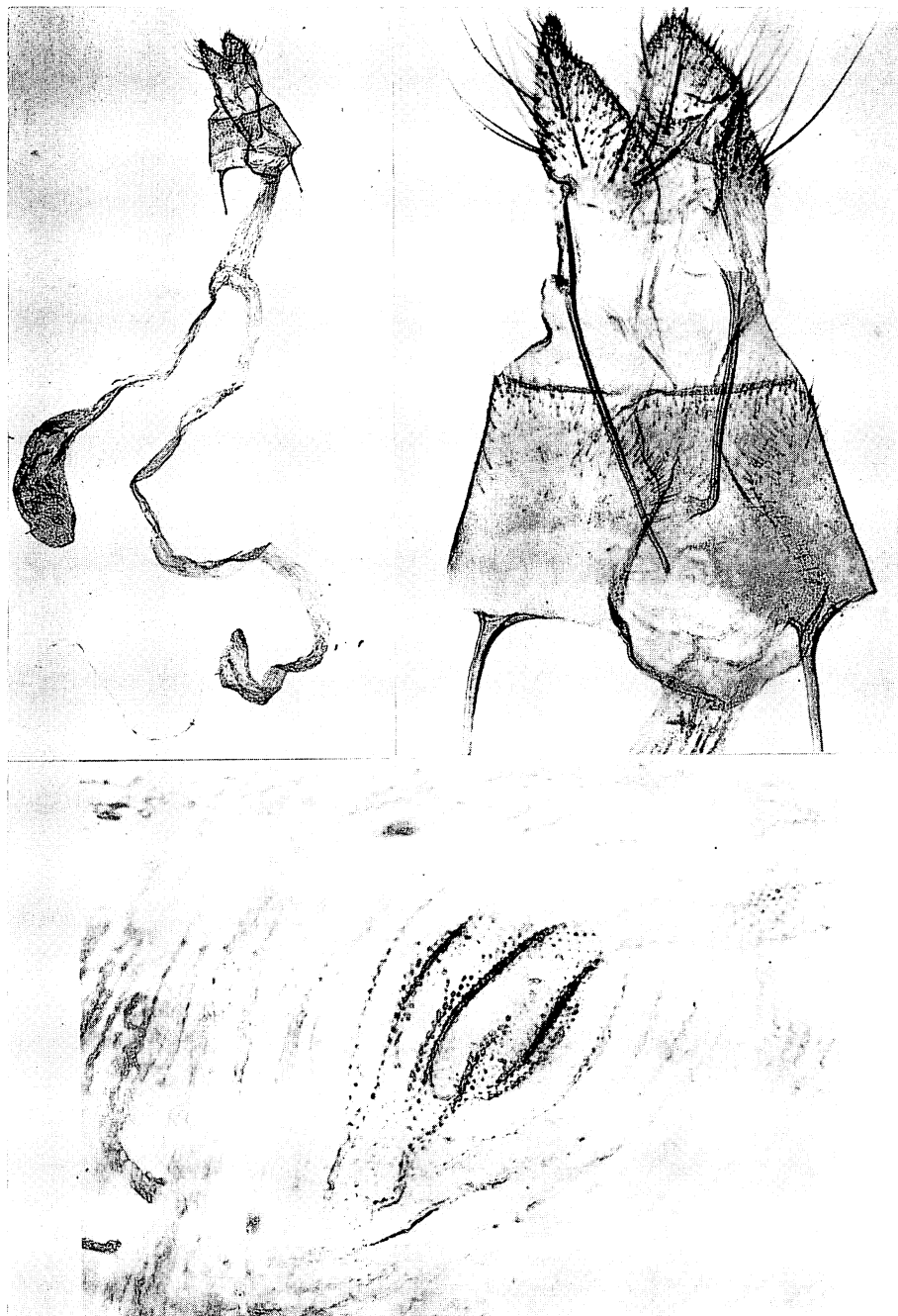


Figure 200—Female genitalia of *Agrotis ipsilon* (Hufnagel); Europe; signum enlarged below.

**Agrotis ipsilon** (Hufnagel) (figs. 170, 172, 197, 200).

*Phalaena Ipsilon* Hufnagel, 1766:416.

*Noctua suffusa* Schiffermueller, 1775:80. Butler, 1880:7.

*Phalaena ypsilon* (Rottemburg), Meyrick, 1899:143. Hampson, 1903:368, fig.

71. Van Dine, 1905:4, fig. 1. Fullaway, 1911:7, fig. 2.

*Rhyacia ypsilon* (Rottemburg) Warren, 1912:52, pl. 6k.

The black, or greasy cutworm.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii, French Frigate Shoal.

Immigrant: Nearly cosmopolitan, and widespread in the Pacific. First recorded from Hawaii by Butler (1879:269) as "*Agrotis suffusa* W.V."

Hostplants: The caterpillars feed on many garden and farm products; garden beans (the larvae may cut off seedlings at ground level), broccoli, carrot, Chinese spinach, corn, cabbage, eggplant, lettuce, potato (may attack tubers in ground and eat a cavity equal to the bulk of a larva in one night), *Sonchus*, tobacco, tomato, turnip, sugarcane, sweetpotato and other plants.

Parasites: Possibly all of the following: *Archytas cirphis* Curran, *Chaetogaedia monticola* (Bigot), *Chelonus texanus* Cresson, *Eucelatoria armigera* (Coquillett), *Euplectrus plathypenae* Howard, *Hyposoter exiguae* (Viereck), *Meteorus laphygmae* Viereck, *Pseudamblyteles koebelei* (Swezey), *Pterocormus rufiventris* (Bruellé).

Predator: *Calosoma blaptoides tehucanum* (Lapouge).

It is a typical cutworm in its feeding habits, i.e., feeding on plants at night-time, often cutting off small plants at or below the surface of the soil, and hiding under leaves, trash, or burrowing in the soil during the daytime. It is a very general feeder, attacking nearly all kinds of garden and field crops, and even weeds. I have never found it very abundant in cane fields, nor have I known of it being reported so, though it does frequently occur along with other species and is partially responsible for the damage done. I have found them in fields of young cane, when no evidence could be found of their having eaten the cane. They were beneath plants of pigweed (Purslane) upon which they must have fed. In the United States they are particularly troublesome to corn, cotton, cabbage, tomato, and tobacco, attacking the young plants, one cutworm often destroying several plants in one night. In India they are destructive to young tea and coffee plants and opium.

The eggs are domeshaped, about 0.5 mm. in diameter, and creamy white in color. There is a small circular depression at the upper pole from which radiate numerous ridges running down the sides to the base or surface in contact with a leaf. The eggs are laid on the surface of leaves or stems of plants near to the ground. From one to many eggs may be placed close together in one batch, and one moth may produce several batches amounting to two to four hundred eggs.

The larvae hatch from the eggs in a few days (usually two to four). They molt five times at intervals of two to six days and become full-grown in about one month. The full-grown caterpillar . . . is about 1.75 inches long (45 mm.). It is of a nearly uniform dark greasy gray color, paler below. The spiracles are black, The tubercles are conspicuous, showing as regular rows of brownish dots. Head and dorsal part of segment behind head dark brown.

The pupa is formed in an earthen cell a little below the surface of the soil. It is about .75 inch long (20 to 23 mm.), uniform medium brown in color, with a dark dorsal band at apex of abdominal segments 4, 5, 6 and 7, containing irregularly arranged small pits. At the tip of abdomen are two large tapering spines, black at base and pale at tip, a little distance apart at base, slightly diverging but curved together at their tips. (Swezey, 1909:19-21.)

**Agrotis kerri** (Swezey), **new combination** (figs. 201, 202, 203).

*Euxoa kerri* Swezey, 1920:378.

Endemic. French Frigate Shoal (type locality).

Hostplants: *Boerhaavia tetrandra*, *Portulaca oleracea*.

"Caterpillar. Length when full-grown about 50 mm. It resembles the caterpillar of *Agrotis crinigera* except that the head is paler, almost entirely pale yellowish testaceous with slender black line along paraclypeal suture where *crinigera* has quite a wide blackish mark. The cervical shield is also paler than that of *crinigera*." (Swezey, 1920:378-379.) "Two of the moths were taken on board the "Tanager" two miles off shore." (Swezey, 1926:73.)

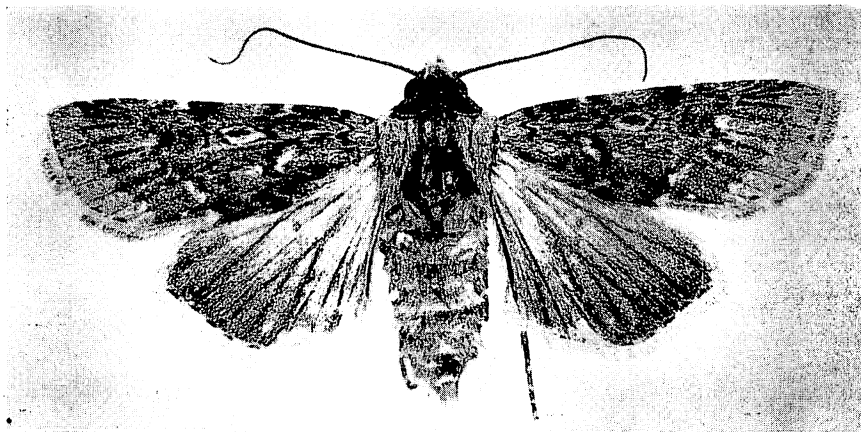


Figure 201—Above: *Agrotis kerri* (Swezey), paratype; French Frigate Shoal; expanse, 34 mm. Below: *laysanensis* (Rothschild), type; expanse, 35 mm.; figured by Rothschild, 1895, pl. 10.

***Agrotis laysanensis* (Rothschild), new combination** (figs. 201, 202).

*Prodenia laysanensis* Rothschild, 1894:539, pl. 10, fig. 10 (in vol. 2, 1895).

Endemic. Laysan (type locality).

Hostplant: Unknown.

Warren (1912:49) listed this species as a synonym of *cremata*, but I cannot agree with that conclusion.



Figure 202—Male genitalia of *Agrotis kerri* (Swezey), French Frigate Shoal (the print is reversed) (above), and the type of *laysanensis* (Rothschild) (below).

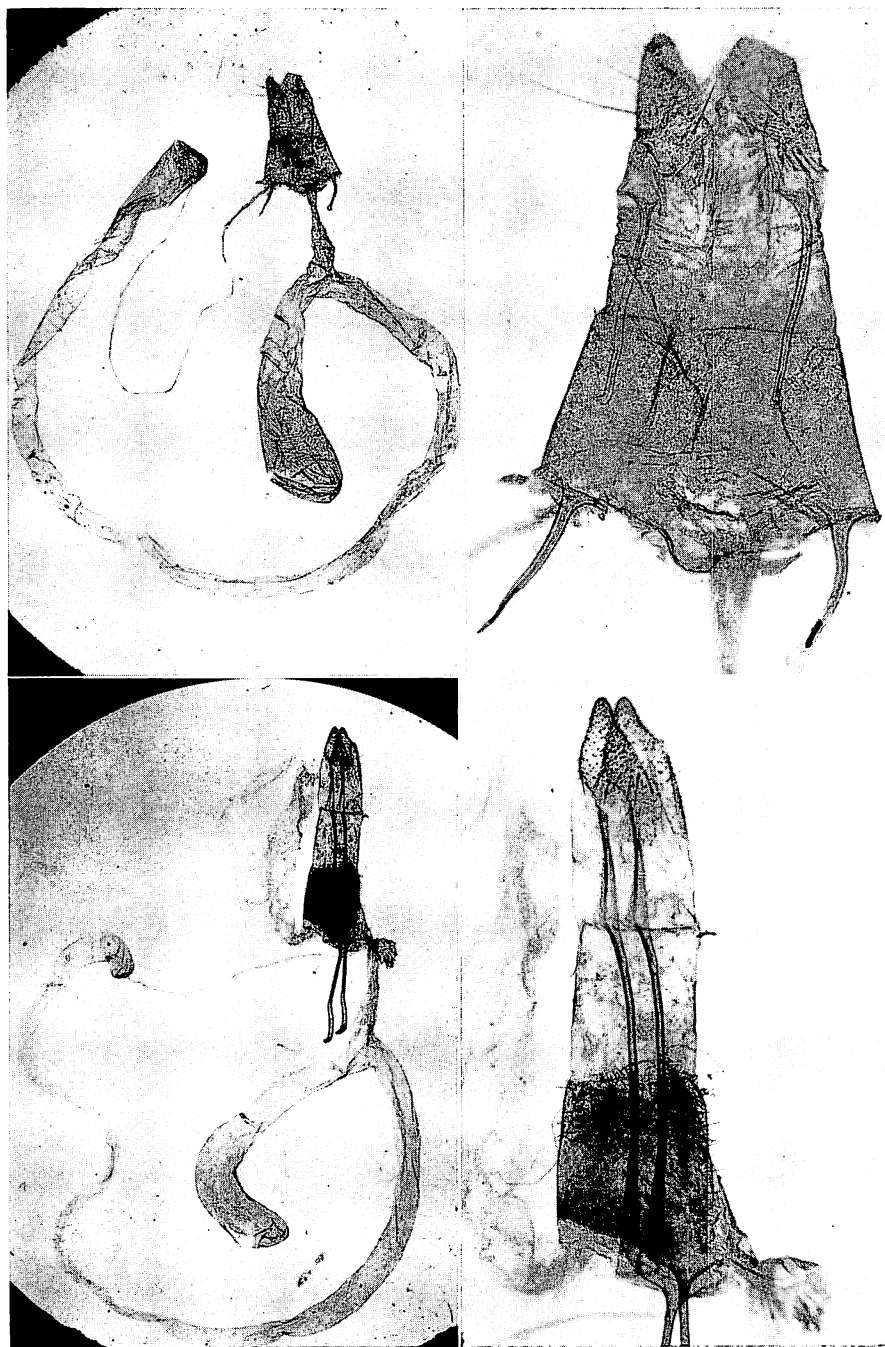


Figure 203—Female genitalia of *Agrotis*. Above: *kerri* (Swezey); French Frigate Shoal. Below: *mesotoxa* Meyrick, type; Kona, Hawaii.



***Agrotis melanoneura*** Meyrick (figs. 177, 179, 204, 205, 207).

*Agrotis melanoneura* Meyrick, 1899:146.

*Euxoa melanoneura* (Meyrick) Hampson, 1903:188, pl. LXV, fig. 22. Warren, 1912:57, pl. 6h.

*Agrotis austalea* Meyrick, 1899:152. **New synonym.**

*Euxoa austalea* (Meyrick) Hampson, 1903:282, pl. LXV, fig. 23. Warren, 1912: 51, pl. 6h.

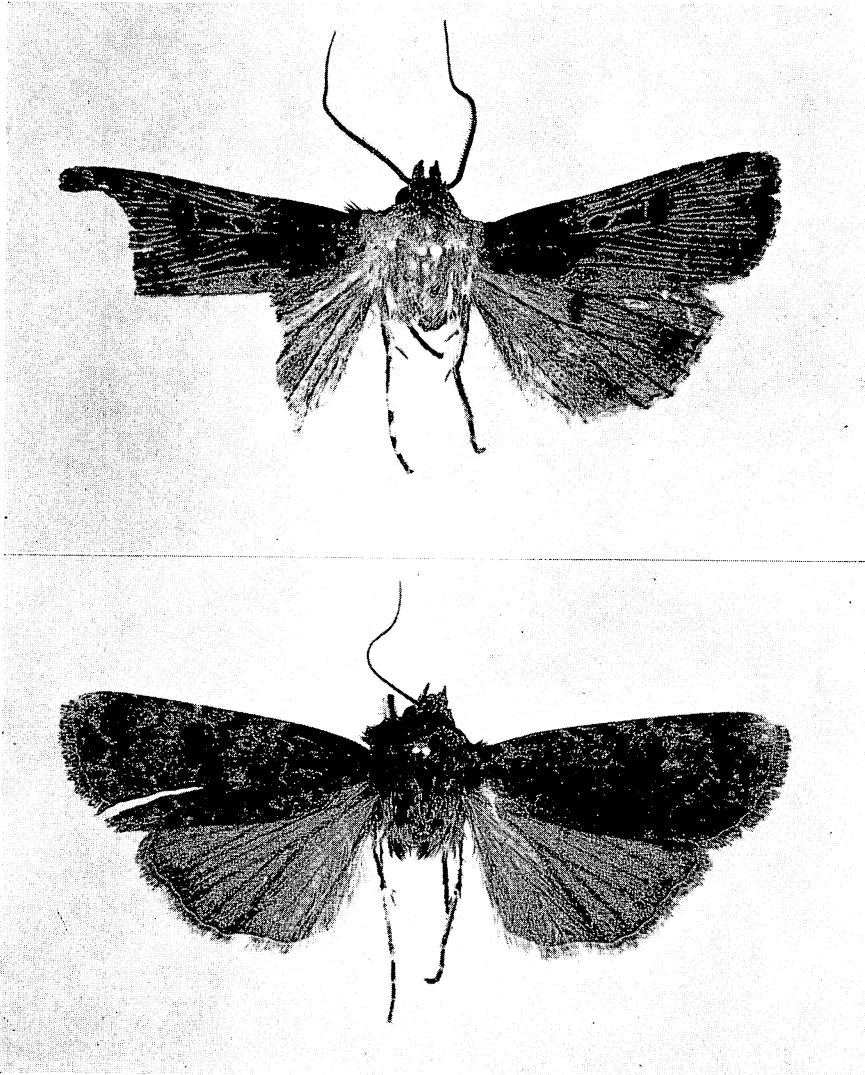


Figure 204—Above: *Agrotis melanoneura* Meyrick, type male; Kona, Hawaii, 4,000 feet; expanse, 37 mm. Below: *mesotoxa* Meyrick, type female; Kona, Hawaii, 4,000 feet; expanse, 43 mm.

*Euxoa austalea* "ab. 1" Hampson, 1903:282.

*Euxoa austalea* "ab. *obscurata*" Warren, 1912:51.

Endemic. Kauai, Hawaii (type locality: Kona, 4,000 feet).

Hostplant: Unknown.

The types of *austalea* and *melanoneura* were taken at the same time and place, and a careful study of the material leads me to the conclusion that only one species is involved and that *austalea* must be reduced to a synonym.

***Agrotis mesotoxa*** Meyrick (figs. 203, 204).

*Agrotis mesotoxa* Meyrick, 1899:148.

*Euxoa mesotoxa* (Meyrick) Hampson, 1903:188, pl. LX, fig. 30. Warren, 1912: 49, pl. 6f.

Endemic. Kauai, Hawaii (type locality: Kona, 4,000 feet).

Hostplant: Unknown.

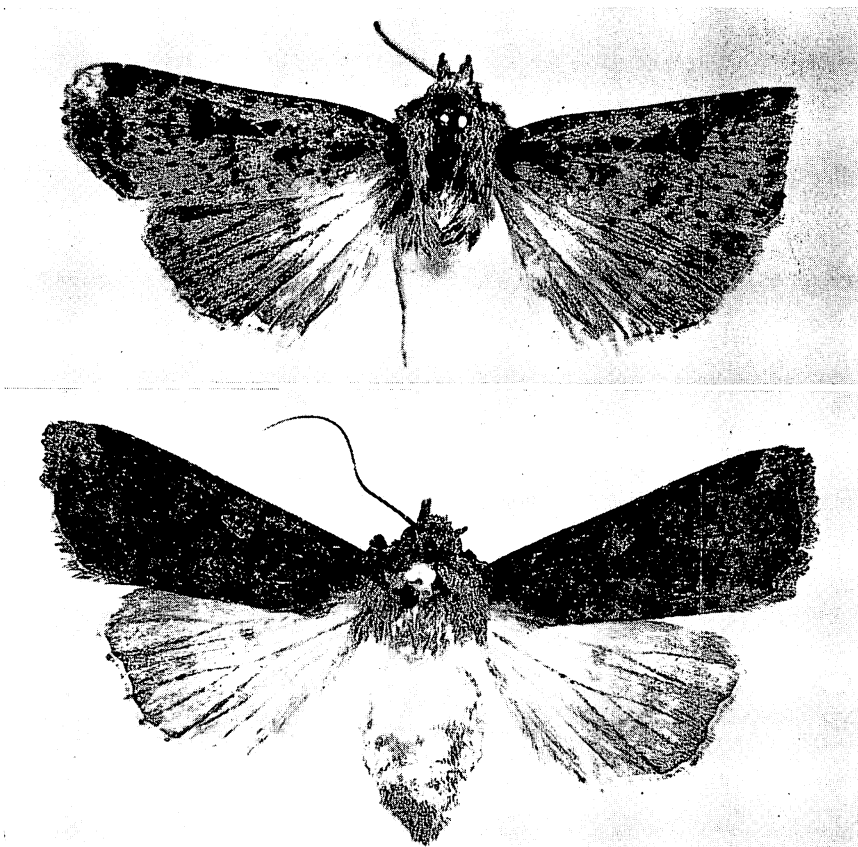


Figure 205—*Agrotis melanoneura* Meyrick. Above: The type of the synonym *austalea* Meyrick; Kona, above 4,000 feet, Hawaii; expanse, 30 mm. Below: Another color form—the synonym *austalea* "ab. 1" Hampson.

***Agrotis microreas*** Meyrick (figs. 171, 206, 207, 213).

*Agrotis microreas* Meyrick, 1899:143, pl. 4, fig. 4.

*Agrotiphila microreas* (Meyrick) Hampson, 1903:132, pl. LIX, fig. 14.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

This distinctive species is the smallest of the genus in Hawaii. It is known only

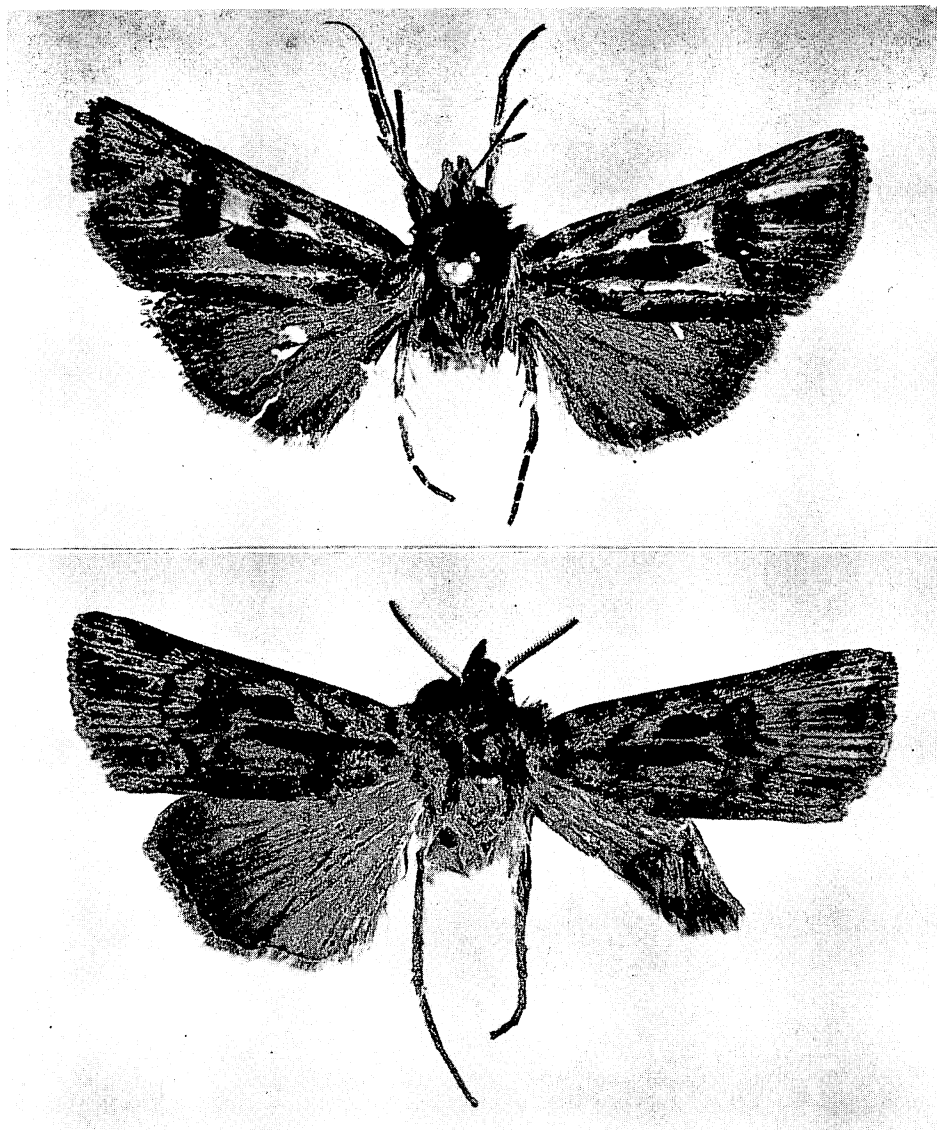


Figure 206—Above: *Agrotis microreas* Meyrick, type female; Kilauea, Hawaii; expanse, 26 mm. Below: The male type of *panoplias* Meyrick; Kona, Hawaii, 4,000 feet; expanse, 37.5 mm.

from the type pair (although Perkins, 1913:cxlvi, said that he had seen it in great numbers flying freely in the morning sunshine over low vegetation including *Vaccinium* and *Styphelia*). Hampson placed it in the genus *Agrotiphila*, but, al-



Figure 207—Male genitalia of *Agrotis*. Above: The type of *melanoneura* Meyrick; Kona, Hawaii, 4,000 feet. Below: *microreus* Meyrick; Kilauea, Hawaii; right valve removed.

though it bears a superficial resemblance to some species of that genus, it has nothing to do with *Agrotiphila*, and Hampson's assignment was in error. The species appears isolated from most of our species.

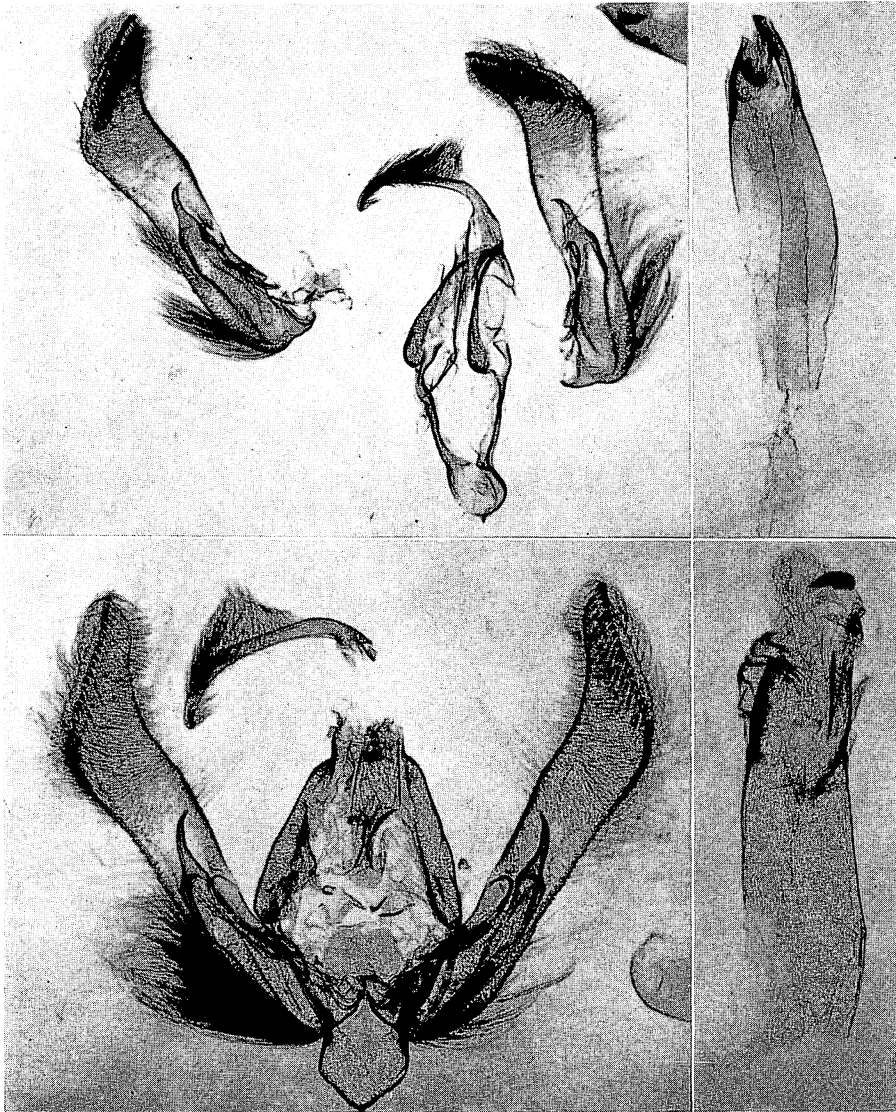


Figure 208—Male genitalia of *Agrotis*. Above: The type of *panoplias* Meyrick; Kona, Hawaii; from a remounted old dissection in poor condition. Below: *perigramma* Meyrick; Kilauea, Hawaii.

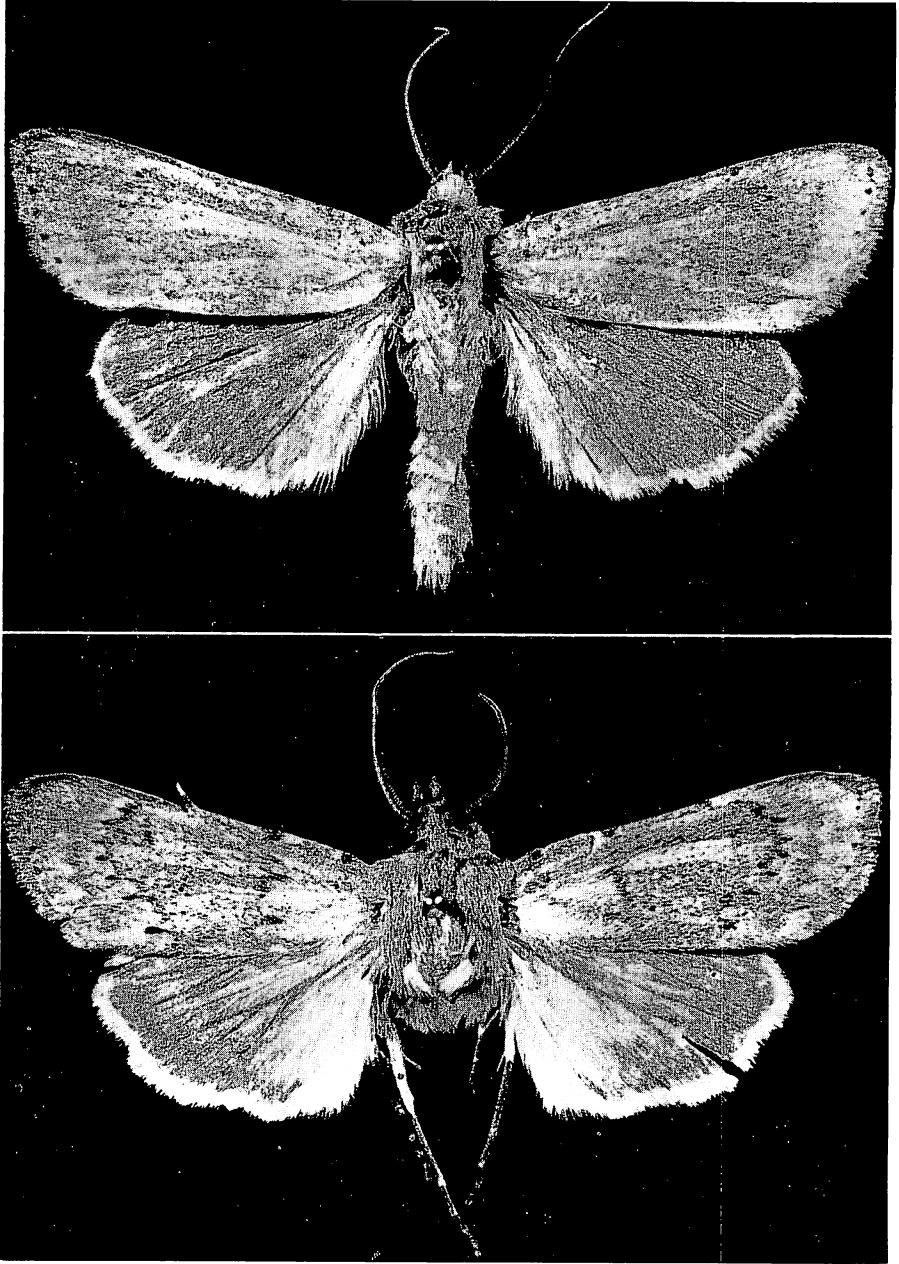


Figure 209—*Agrotis photophila* (Butler). Above: The male type; "Hawaii, Honolulu, Blackburn, 79-8 No. 60"; expanse, 36 mm. Below: The male type of the synonym *lucicolens* Butler; "Honolulu Blackburn 80-31"; expanse, 42 mm.

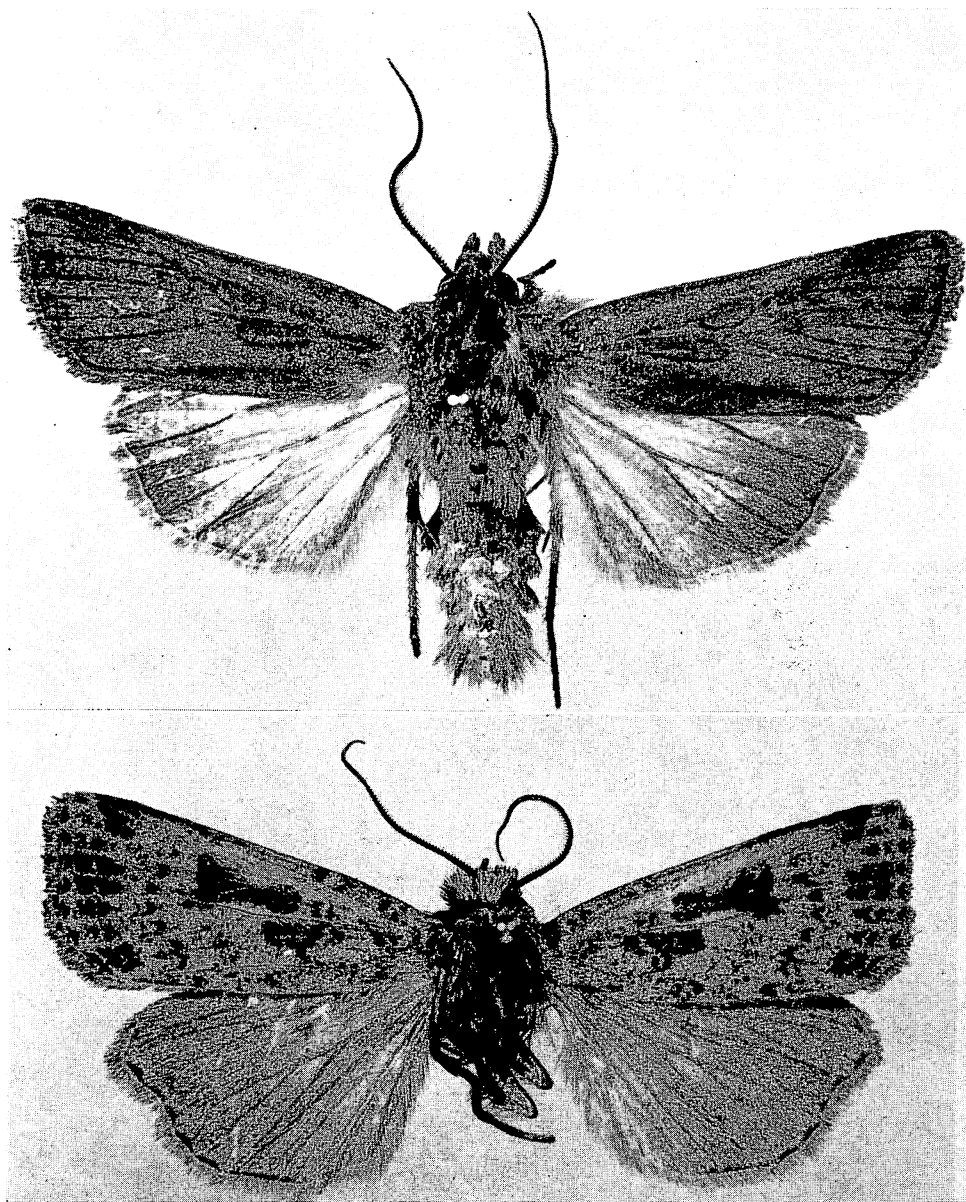


Figure 210—Above: *Agrotis perigramma* Meyrick, male type; Kilauea, Hawaii; expanse, 37 mm. Below: The male type of *psammophaea* Meyrick; Haleakala, 5,000 feet; expanse, 37 mm.

***Agrotis panoplias* Meyrick (figs. 206, 208).**

*Agrotis panoplias* Meyrick, 1899:144, pl. 4, fig. 5.

*Euxoa panoplias* (Meyrick) Hampson, 1903:187, pl. LX, fig. 28, Warren, 1912: 149, pl. 6f.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: Unknown.

***Agrotis perigramma* Meyrick (figs. 208, 210).**

*Agrotis perigramma* Meyrick, 1899:145.

*Euxoa perigramma* (Meyrick) Hampson, 1903:193, pl. LXI, fig. 15, Warren, 1912:50, pl. 6g.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

***Agrotis photophila* (Butler) (figs. 209, 212).**

*Leucania photophila* Butler, 1879:269.

*Agrotis photophila* (Butler) Meyrick, 1899:147; 1904:346.

*Euxoa photophila* (Butler) Hampson, 1903:193, pl. LXI, fig. 14, Warren, 1912: 50, pl. 6g.

*Spaelotis lucicolens* Butler, 1880:7. Synonymy by Meyrick, 1899:147.

*Euxoa lucicolens* (Butler) Hampson, 1903:192, pl. LXI, fig. 13, Warren, 1912: 50, pl. 6g.

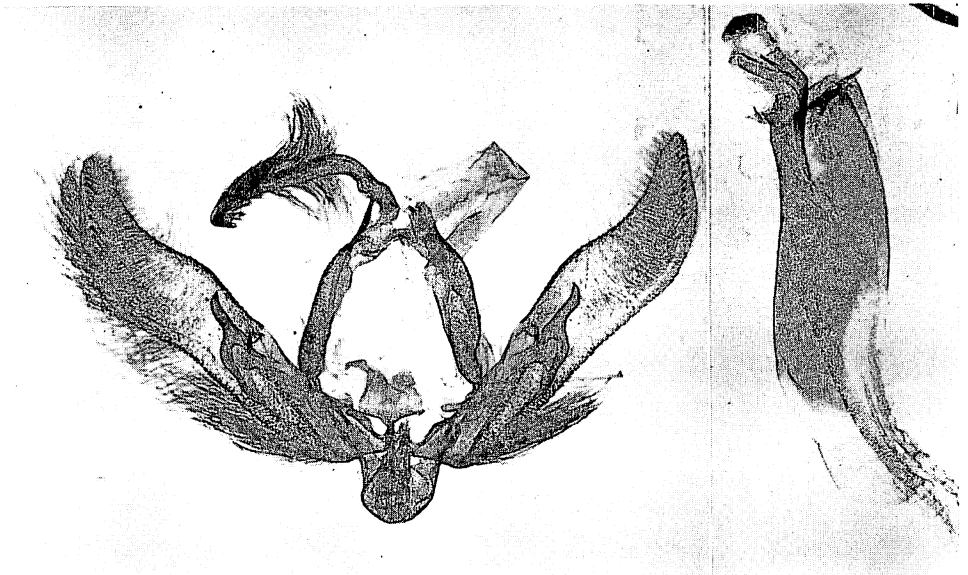


Figure 211—Male genitalia of the type of *Agrotis psammophaea* Meyrick; Haleakala, Maui, 5,000 feet.



Endemic. Oahu (type locality: near Honolulu).

Hostplant: Unknown.

I have checked the genitalia of the types in the British Museum and agree with

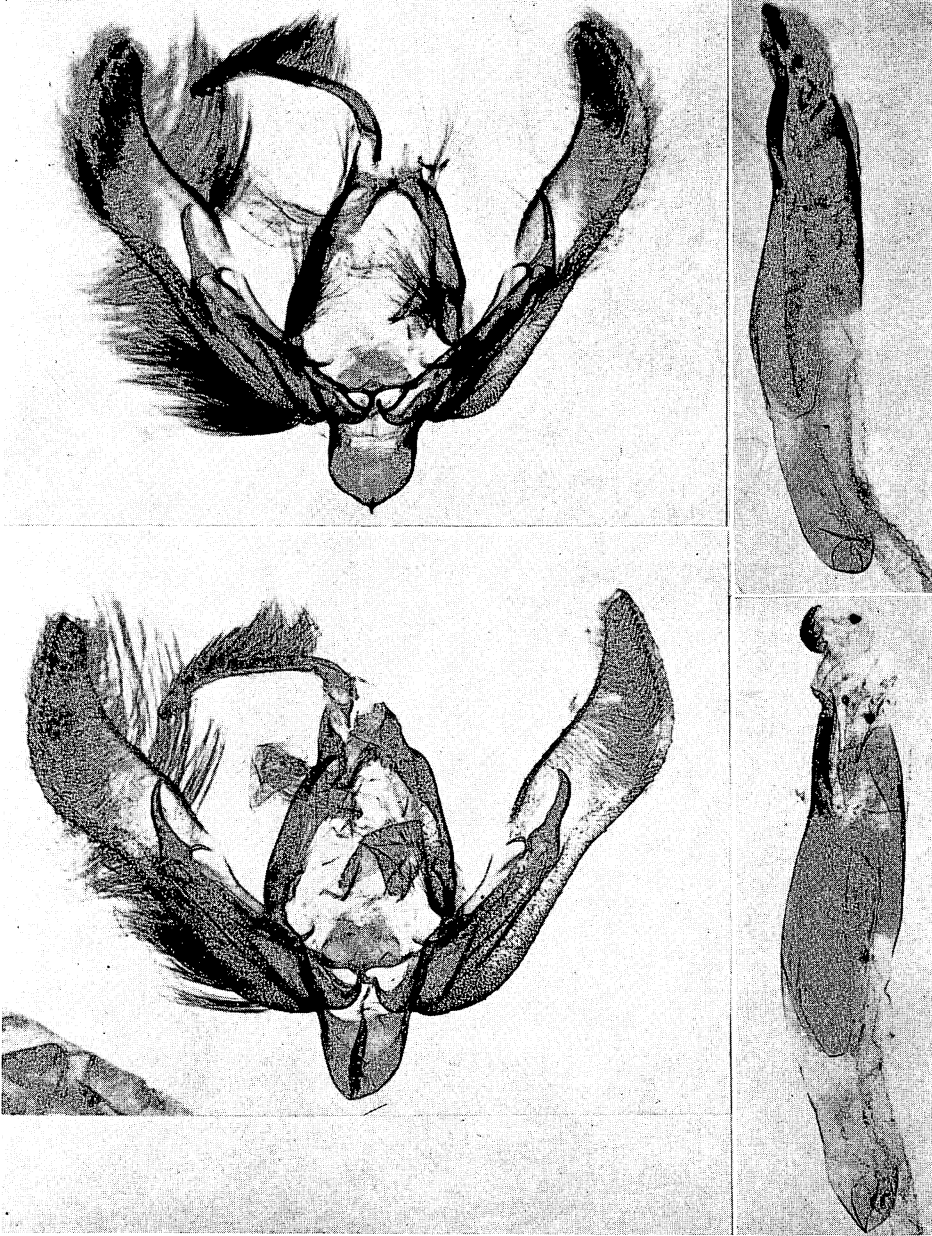


Figure 212—Male genitalia of *Agrotis*. Above: *photophila* (Butler); Oahu. Below: The type of the synonym *lucicolens* Butler; Honolulu.

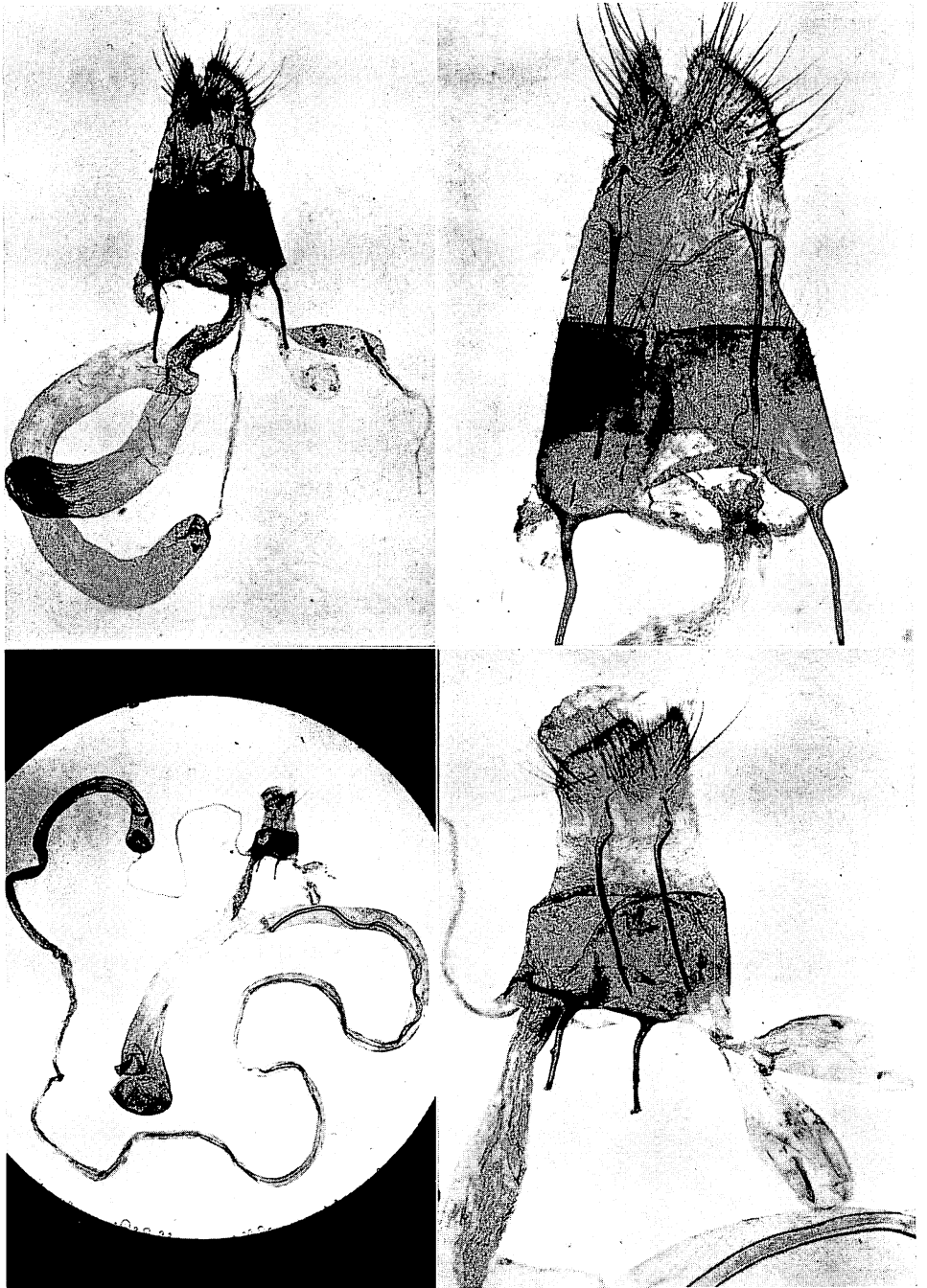


Figure 213—Female genitalia of *Agrotis*. Above: The type of *microreos* Meyrick; Kilauea, Hawaii. Below: *psammophaea* Meyrick; Haleakala, Maui; (note the spermatophore).

Meyrick's synonymy. Warren (1912:50) listed *fasciata* (Rothschild) as a "form" of this species, but I consider them distinct species.

This species was taken in the lowlands, especially near the sea, of Oahu by both Blackburn and Perkins, but I have no records of its having been captured by any other collectors. Could it have been exterminated?

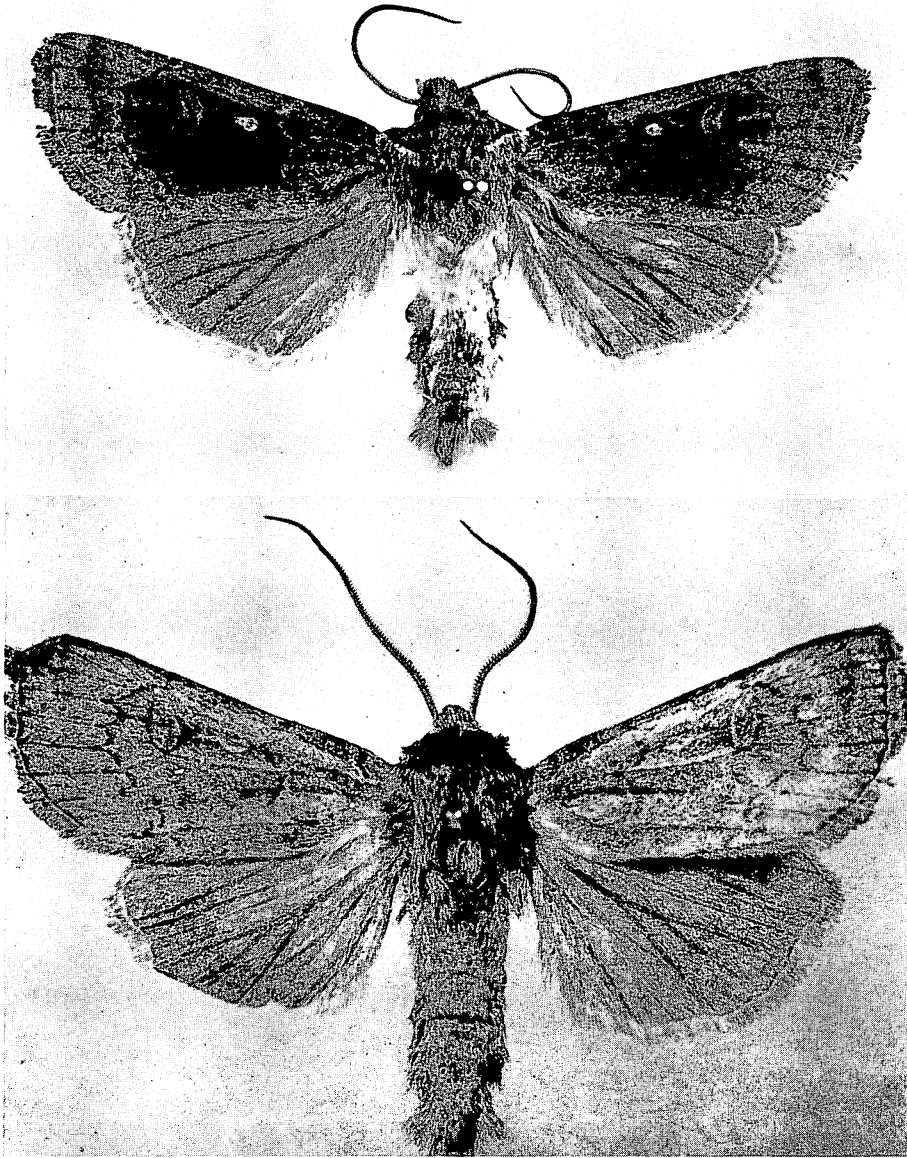


Figure 214—*Agrotis tephrias* Meyrick. Above: The male type; Kaholuamano, Kauai; expanse, 40 mm. Below: The male type of the synonym *spoderopa* Meyrick; Haleakala, Maui, 5,000 feet; expanse, 38 mm.

***Agrotis procellaris* Meyrick.**

*Agrotis procellaris* Meyrick, 1900:258.

*Euxoa procellaris* (Meyrick) Hampson, 1903:217, pl. LXIV, fig. 1. Warren, 1912:50, pl. 6g.

Endemic. Laysan (type locality).

Hostplant: Unknown.

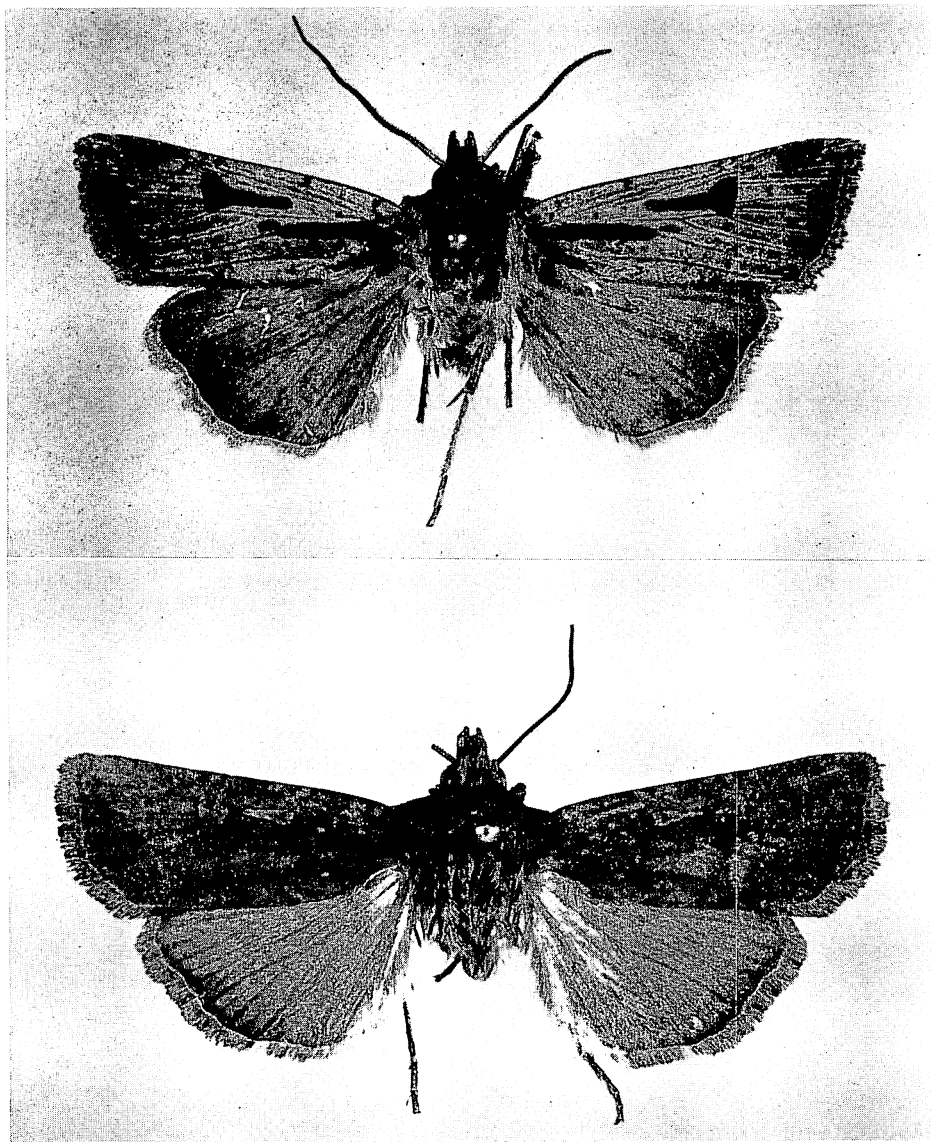


Figure 215—*Agrotis xiphias* Meyrick. Above: The male type; Haleakala, Maui, 5,000 feet; expanse, 38 mm. Below: A male of "ab. 1," a color form; Haleakala, Maui, 5,000 feet; expanse, 35 mm. See figure 217 for genitalia of these examples.

This species was described from two examples taken by Schauinsland on Laysan, and the specimens are in Bremen. I was unsuccessful in obtaining the material on loan for study when I was preparing this text at the British Museum. There is, however, a colored drawing of the species in one of the drawers at the British Museum in a space reserved for the species. The illustration indicates that this species resembles *crinigera*, but the claviform spot is strongly marked in the drawing.

**Agrotis psammophaea** Meyrick (figs. 210, 211, 213).

*Agrotis psammophaea* Meyrick, 1899:151, pl. 4, fig. 11.

*Euxoa psammophaea* (Meyrick) Hampson, 1903:246, pl. LXIII, fig. 26. Warren, 1912:50, pl. 6h.

Endemic. Kauai, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Unknown.

**Agrotis tephrias** Meyrick (figs. 214, 216).

*Agrotis tephrias* Meyrick, 1899:147.

*Euxoa tephrias* (Meyrick) Hampson, 1903:192, pl. LXI, fig. 12. Warren, 1912:50, pl. 6f.

*Agrotis spoderopa* Meyrick, 1899:148, pl. 4, fig. 8. **New synonym.**

*Euxoa spoderopa* (Meyrick) Hampson, 1903:192, pl. LXI, fig. 11. Warren, 1912:49, pl. 6f.

Endemic. Kauai (type locality: Kaholuamano), Maui.

Hostplant: Unknown.

I find the paler form from Maui which Meyrick called *spoderopa* to be the same as his *tephrias*. The type of *tephrias* has the discal areas of the fore wings considerably darker than the same areas on the type of *spoderopa*, as the illustrations show, but the basic pattern is the same.

**Agrotis xiphias** Meyrick (figs. 173, 215, 217, 219).

*Agrotis xiphias* Meyrick, 1899:146, pl. 4, fig. 7.

*Feltia xiphias* (Meyrick) Hampson, 1903:351, pl. LXVIII, fig. 11.

*Feltia xiphias* "ab. 1" Hampson, 1903:351.

*Euxoa xiphias* (Meyrick) Warren, 1912:51, pl. 6h.

*Euxoa xiphias* aberration *rufescens* Warren, 1912:51 (for Hampson's "ab. 1").

*Feltia xiphias* "ab" *xiphioides* Strand, 1916:145.

Endemic. Kauai, Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Unknown.

This is a distinctively marked species whose pattern is subject to considerable variation.

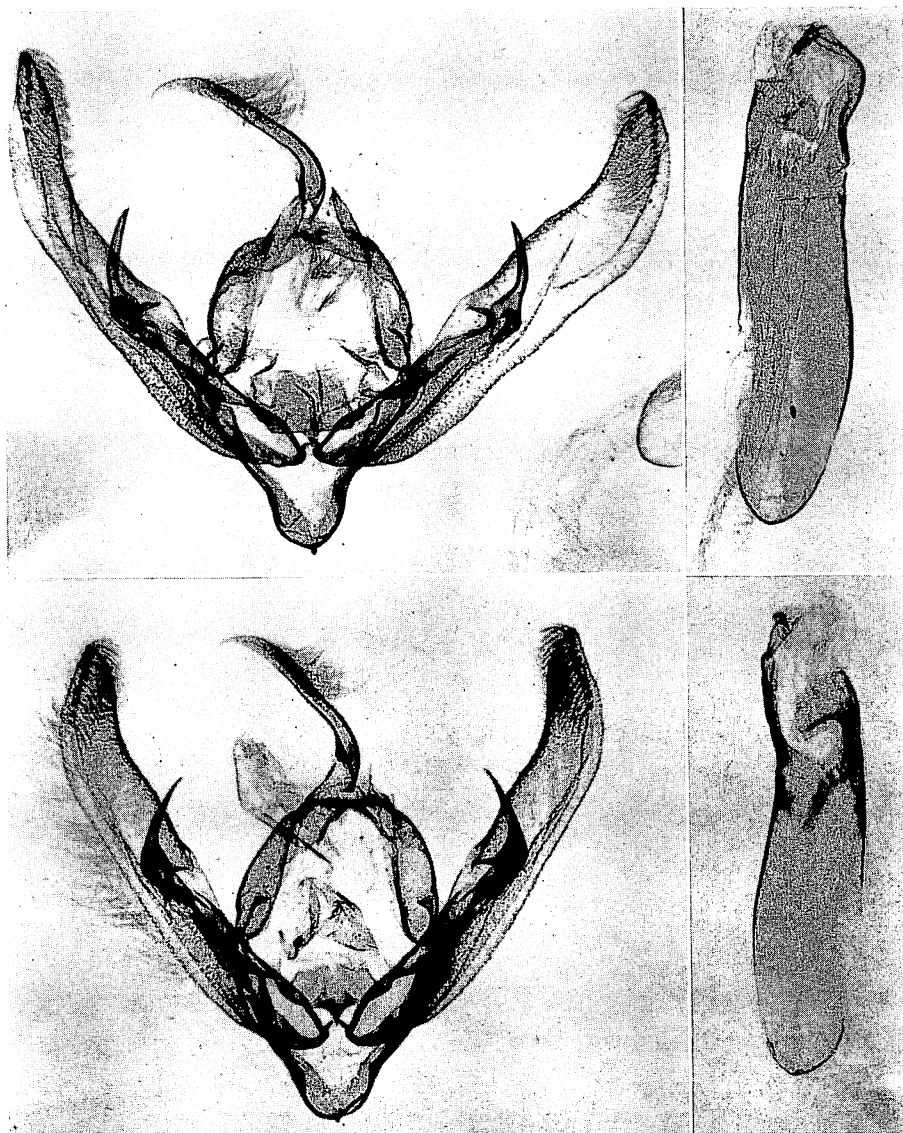


Figure 216—Male genitalia of *Agrotis tephrias* Meyrick. Above: An example from the Waimea Mts., Kauai. Below: An example from the series of the synonym *spoderopa* Meyrick; Haleakala, Maui, 5,000 feet. Opposite sides of the aedeagi are shown.



Figure 217—Male genitalia of *Agrotis xiphias* Meyrick. Above: The type; Haleakala, Maui, 5,000 feet. Below: A specimen of "ab. 1" from the same locality; the internal sac of the aedeagus is not pulled out of this example as it is from the specimen illustrated at top. The specimens from which these organs were taken are illustrated in figure 215.



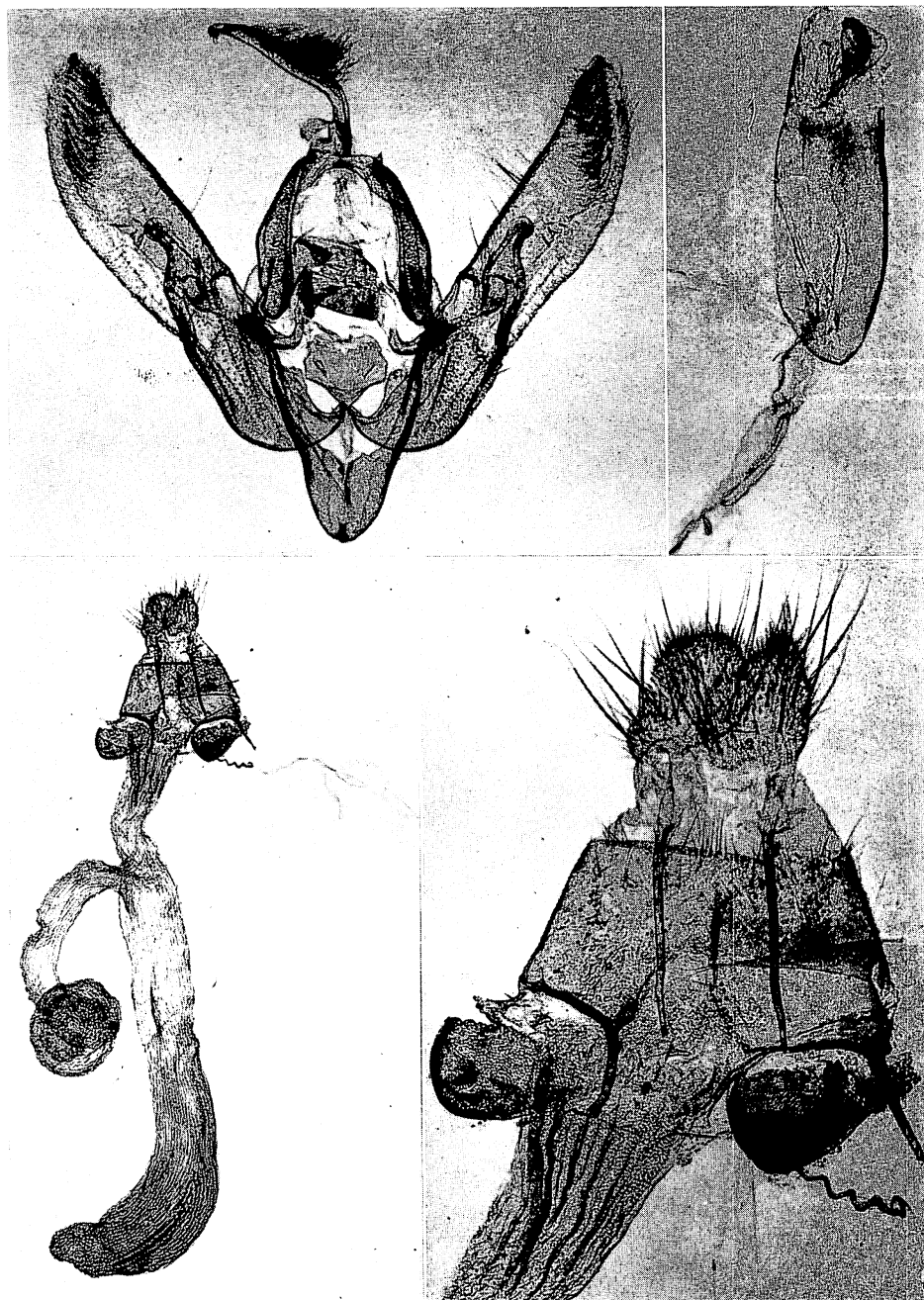


Figure 218—Male and female genitalia of the type of *Agrotis*, the European *segetum* Denis and Schiffermueller; specimens from Germany.





Figure 219—Female genitalia of *Agrotis xiphias* Meyrick; Haleakala, Maui, 5,000 feet.

#### Genus **PERIDROMA** Huebner, 1821

The only species heretofore assigned to this genus in Hawaiian literature have been incorrectly placed in it, and the species which should have been listed under this name were placed in *Agrotis*. Moreover, the forms named by Warren in 1912 have been overlooked in Hawaii. Warren placed all of our species in *Rhyacia*, where he also incorrectly assigned some of our *Agrotis*. *Peridroma* is a widespread genus whose type is the widespread *porphyrea* (Denis and Schiffermueller). The species are much like those of *Agrotis*, but the fore tibiae lack the numerous spines on the outer edge which are present in *Agrotis*, and the genitalia are of distinctive conformation. The internal sac of the aedeagus is somewhat like that of *Agrotis*. The bursa copulatrix changes greatly in shape and texture following mating. In the virgin female it is slender and corduroy-like, but the ribs disappear after mating. Virgin and mated females might easily be considered to be different species, and I was much confused by this fact until I discovered the changes which take place after mating.

## KEY TO THE HAWAIIAN PERIDROMA

1. Under sides of hind wings mostly delicate purplish or lavender (this color present but usually less evident on dorsum), discs subhyaline, postmedial line absent ..... **porphyrea** (Denis and Schiffermueller).  
Under sides of hind wings not so colored, postmedial line moderate to strongly developed ..... 2
- 2(1). Veins of fore wings strikingly pale-scaled, as in figure 225 ..... **neurogramma** (Meyrick).  
Not so ..... 3
- 3(2). Fore wing with a wide, pale, terminal band which contrasts strongly with remainder of wing, as in figure 224 ..... 4  
Terminal area of fore wing not markedly pale ..... 5
- 4(3). Orbicular spot dark. . **cinctipennis cinctipennis** (Butler).  
Orbicular spot white. . **cinctipennis albistigma** (Warren).
- 5(3). Reniform spot with a thick sub- <-shaped white or pale yellowish mark strongly indenting the distal side, as in figure 223, this pale mark very conspicuous to the unaided eyes; a large species, frequently exceeding 45 mm. in expanse ..... **selenias** (Meyrick).  
Reniform spot without such a strongly marked pale spot, on some examples the pale mark is indicated by a comparatively narrow, pale, indented outer margin of

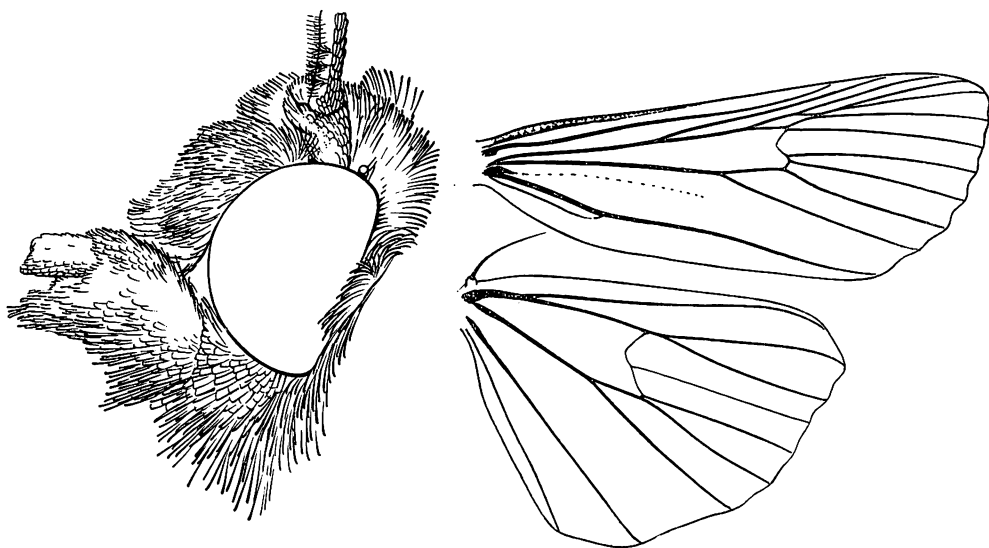


Figure 220—*Peridroma*. Head (left) and wing venation (right) of *porphyrea* (Denis and Schiffermueller).

- reniform, but not as figured for *selenias*; smaller species, usually less than 40 mm. in expanse..... 6
- 6(5). Orbicular spot pale, often largely whitish, even if center contains brown scales, the spot appears distinctly pale on the wing, usually not ovate and not oblique.....  
.....**albiorbis** (Warren).  
Orbicular dark, or dark centered with at most a narrow, whitish margin only (in some examples of *chersotoides*, the white margin may be quite conspicuous and make the spot appear quite pale, but on examples examined the spot is ovate and oblique and the fore wings are definitely more chestnut colored).....7
- 7(6). Medial thoracic crests the same color as tegulae, not markedly paler; orbicular spot appearing comparatively rather pale, the darker enclosed scales largely reddish brown; quite a reddish or chestnut colored species.....**chersotoides** (Butler).  
Medial thoracic crests distinctly paler than tegulae; orbicular conspicuously dark (but not as dark as the dark colored area between orbicular and reniform), mostly grey-scaled, the pale scales outlining the orbicular spot few and forming only a narrow and partial line, if present, but often absent.....8
- 8(7). Fore wing largely yellowish-greyish-brown with darker markings.....**coniotis coniotis** (Hampson).  
Strongly reddish-brown or chestnut colored forms.....  
.....**coniotis rufata** (Warren).  
NOTE: examples of *coniotis* and *rufata* were taken together on Kauai by Perkins, and I believe it best to consider *rufata* as only a color form of *coniotis*. Unfortunately, I have seen no males of *coniotis* except the type whose genitalia are lost.

**Peridroma albiorbis** (Warren), **new status, new combination** (figs. 222, 226, 230).

*Agrotis coniotis* "ab. 1" Hampson, 1903:426.

*Rhyacia* "conistis" (misspelling) "ab." *albiorbis* Warren, 1912:58, pl. 7h.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: Unknown.

The specimen selected as lectotype in the British Museum bears the following field data: "Kona, 4,000 ft. Perkins viii-1892." I have chosen to raise this form to full specific status.

***Peridroma chersotoides* (Butler), new combination** (figs. 223, 226, 234).

*Apamea chersotoides* Butler, 1881:322.

*Agrotis chersotoides* (Butler) Hampson, 1903:425, pl. LXXI, fig. 2.

*Rhyacia chersotoides* (Butler) Warren, 1912:58, pl. 7h.

Endemic. Maui (type locality not more definitely known; Blackburn's field notes state "Various localities on Maui, April and May 1880.").

Hostplant: Unknown, although possibly pokeweed.

Meyrick did not understand this species, and his 1899:151 descriptive material is in error. He also incorrectly submerged *coniotis* Hampson as a synonym (1904:366).

There is much confusion in the literature in reference to this species. In all the British Museum series, the only examples which can rightly be assigned to this species are the original pair taken by Blackburn. It has been recorded from Molokai (caterpillars feeding on pokeweed) and Hawaii, but these references may be in error.

***Peridroma cinctipennis cinctipennis* (Butler), new combination** (figs. 224, 227, 231).

*Apamea cinctipennis* Butler, 1881:323.

*Agrotis cinctipennis* (Butler) Meyrick, 1899:150.

*Rhyacia cinctipennis* (Butler) Warren, 1912:58.

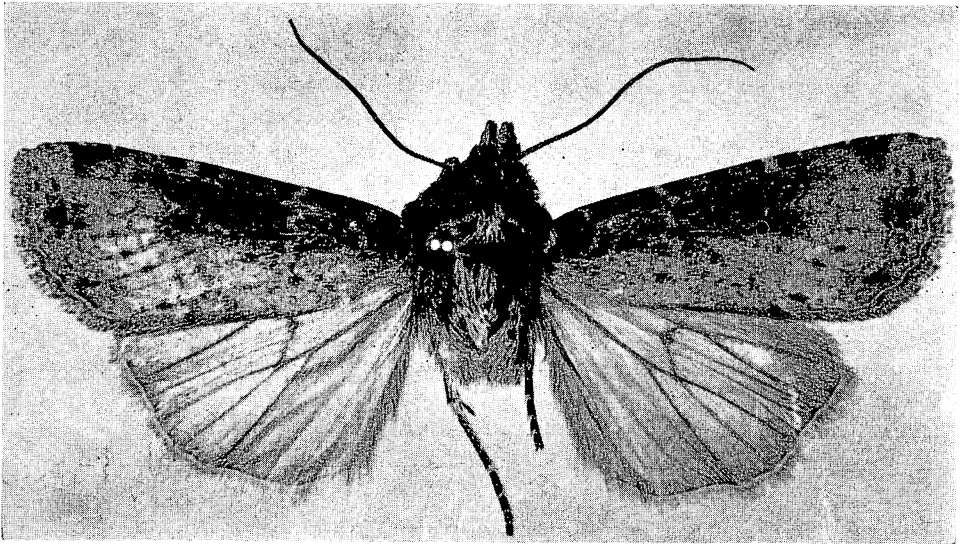


Figure 221—*Peridroma coniotis* (Hampson), male type; Kona, above 4,000 feet; expanse, 37 mm.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Butler (1881:323) said, "I can find no reference to the No. (140) in Mr. Blackburn's notes, and therefore am ignorant as to the exact locality of this species"; from a study of the material, I believe that the type came from Haleakala), Hawaii.

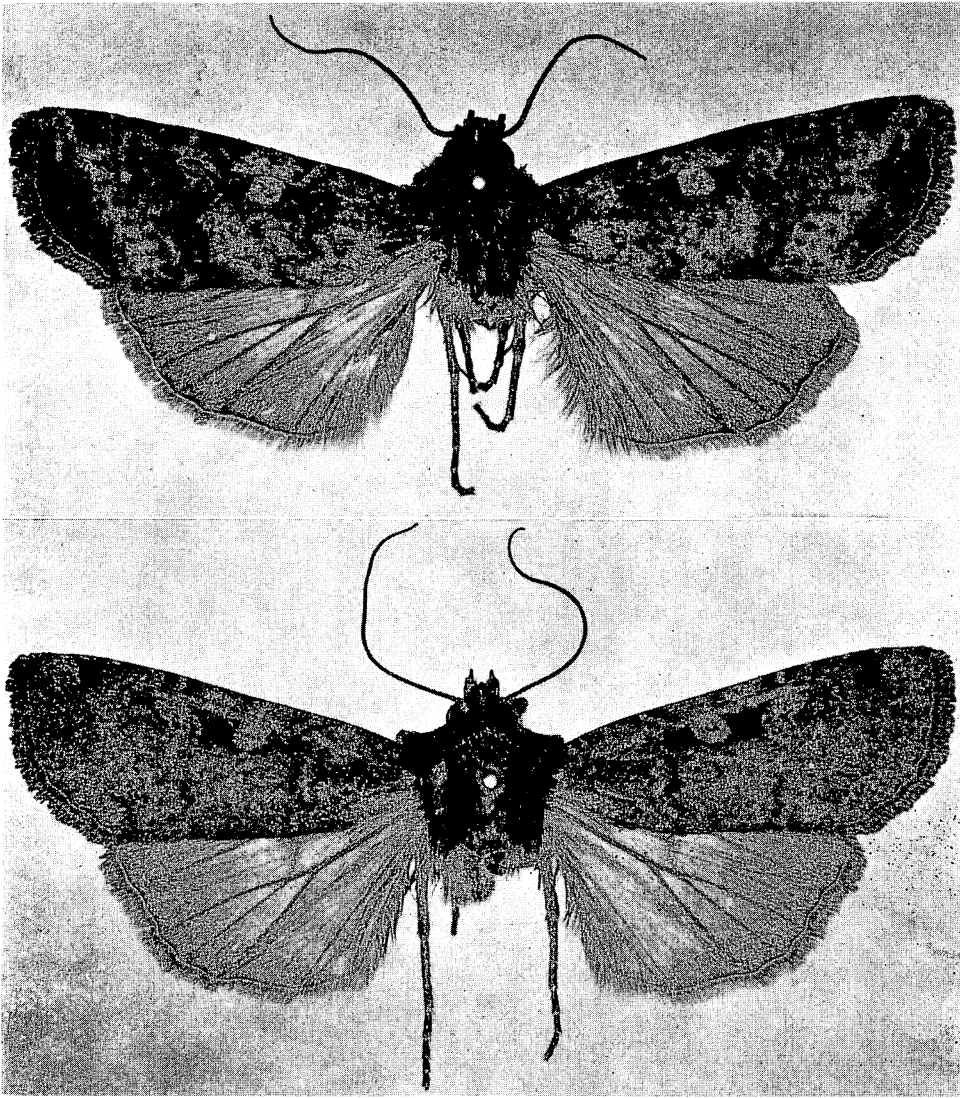


Figure 222—Above: *Peridroma albiorbis* (Warren), lectotype female; Kona, Hawaii, 4,000 feet; expanse, 39 mm. Below: The lectotype female of *coniotis rufata* (Warren); Waimea Mts., Kauai, 4,000 feet; expanse, 37 mm.

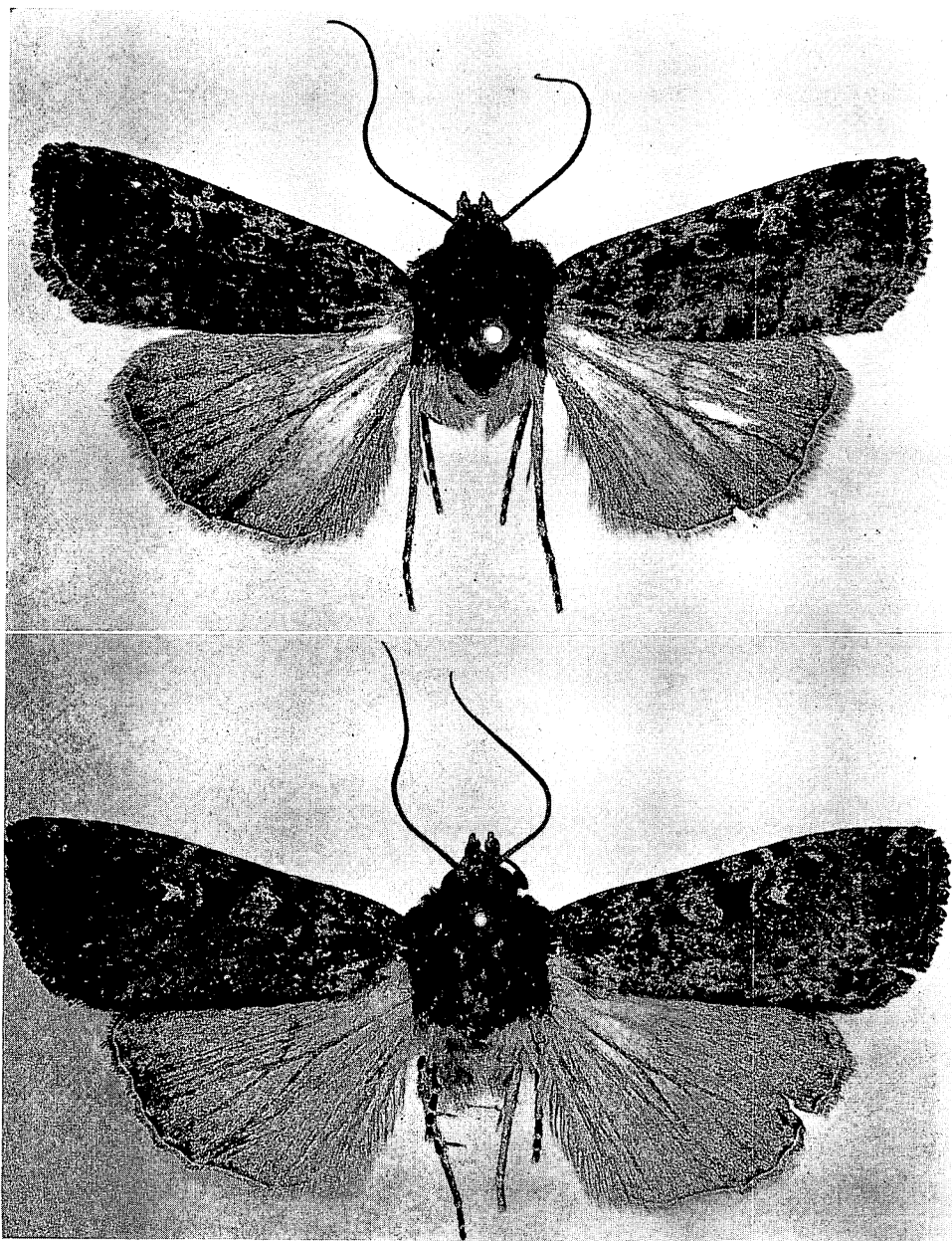


Figure 223— Above: *Peridroma chersotoides* (Butler), male type; "Hawaiian Is. Blkb. 81-7"; expanse, 32 mm. Below: Male type of *selenias* (Meyrick); Waimea Mts., Kauai, 4,000 feet; expanse, 44.5 mm.

Hostplants: *Aleurites moluccana*, *Cheirodendron*, grasses, *Lythrum*, mango, *Metrosideros*, *Pittosporum*, *Sonchus*, (forced feeding in laboratory), *Wikstroemia*.

Parasite: *Chaetogaedia monticola* (Bigot) (parasitization may be heavy).

Dr. Swezey has, on numerous occasions, found the egg clusters, which are not closely compacted, on the leaves of various trees. The young caterpillars feed gregariously.

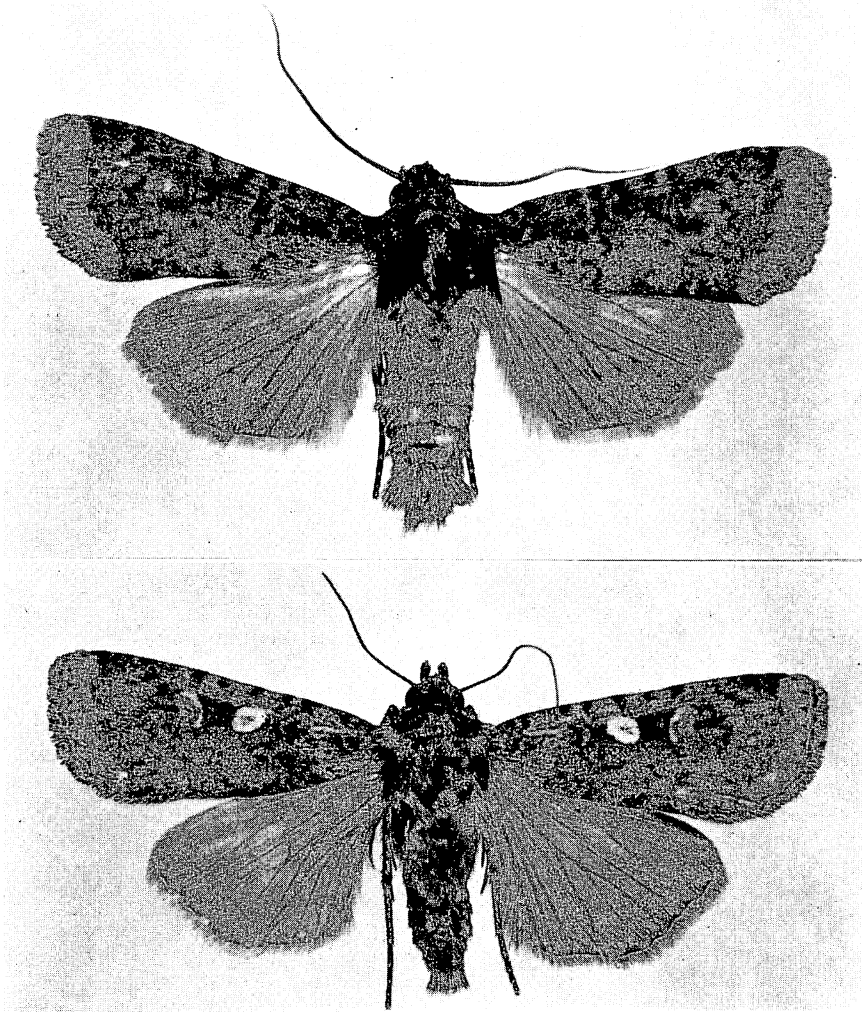


Figure 224— Above: *Peridroma cinctipennis* (Butler), compared with the female type; Malama, Oahu; reared from *Pittosporum*; expanse, 36 mm. Below: *cinctipennis albistigma* (Warren); compared with lectotype; Mt. Tantalus, Oahu; expanse, 38 mm.



There may be more than one form involved in the various host and locality records.

Hampson (1903:425) cited a female from "Oahu, Mt. Waimea." This is in error, and the locality meant may either be Waianae Mountains, Oahu, or Waimea Mountains, Kauai (which Perkins listed as "Mts. Waimea").

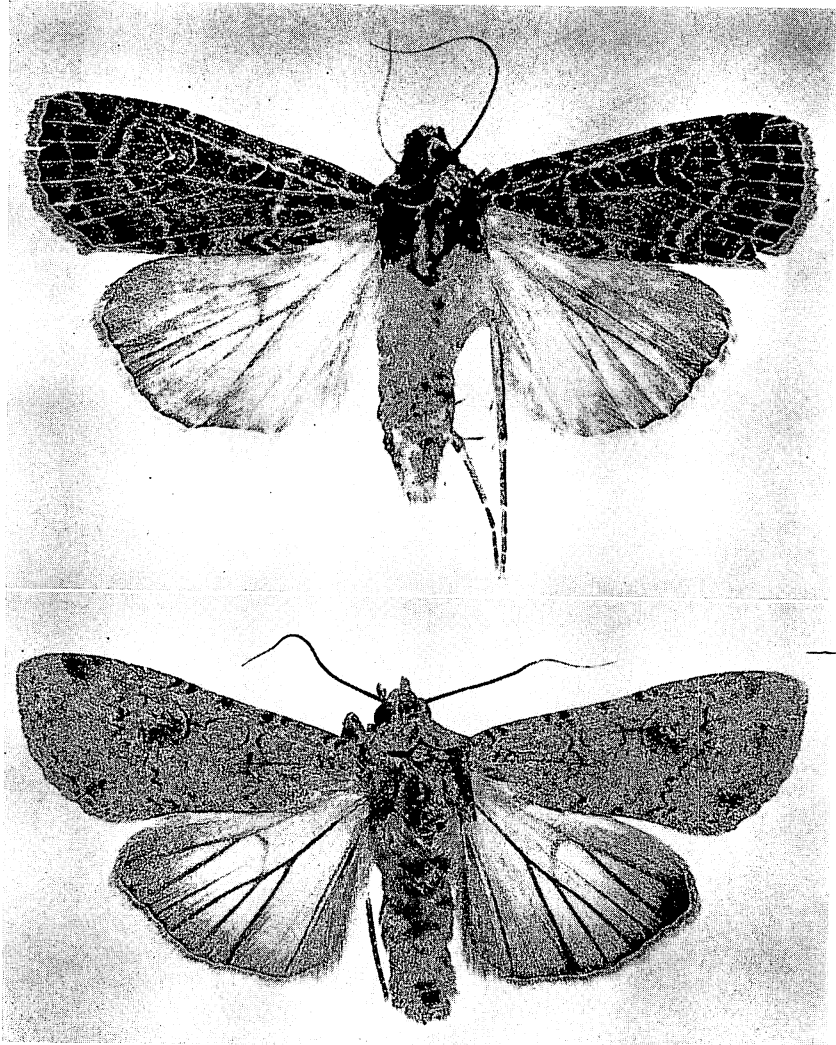


Figure 225—Above: *Peridroma neurogramma* (Meyrick), closely similar to the type; Kilauea, Hawaii; expanse, 53 mm. Below: *porphyrea* (Denis and Schiffmueller); Honolulu; expanse, 47 mm.; reared from green tomato; lines on wings vary in intensity.



***Peridroma cinctipennis albistigma* (Warren), new combination** (figs. 224, 227, 231).

*Rhyacia cinctipennis* "ab." *albistigma* Warren, 1912:58.

Endemic. Oahu (type locality: Honolulu, 1,500 feet).

Hostplant: Unknown.



Figure 226—Male genitalia of *Peridroma*. Above: *albiorbis* (Warren); Kilauea, Hawaii. Below: Type of *chersotoides* (Butler), with internal sac extruded from aedeagus.

***Peridroma coniotis coniotis* (Hampson), new combination** (figs. 221, 232).

*Agrotis coniotis* Hampson, 1903:426, pl. LXXI, fig. 3; new name for *Agrotis chersotoides* in the sense of Meyrick, 1899:151, not Butler.

*Rhyacia conistis* (misspelling) (Hampson) Warren, 1912:58, pl. 7h.

Endemic. Kauai, Hawaii (type locality: Kona, over 4,000 feet).

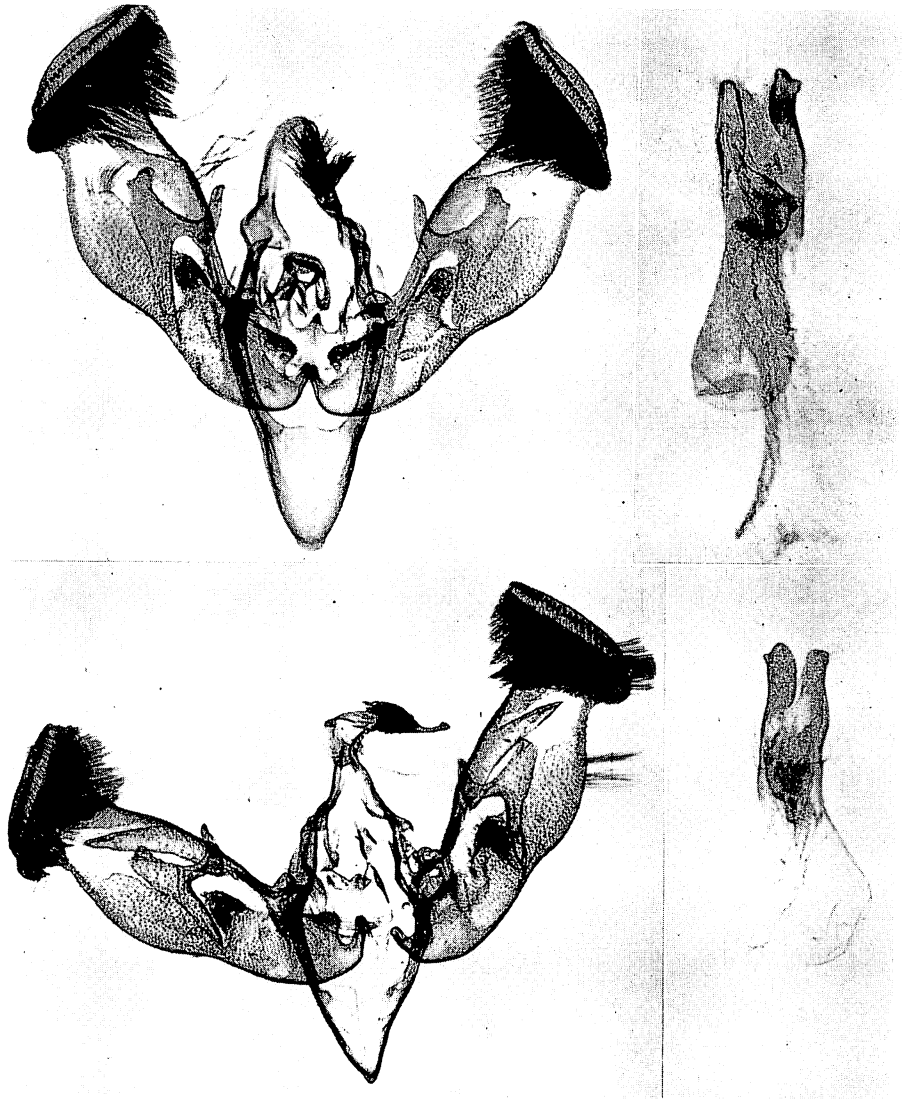


Figure 227—Male genitalia of *Peridroma*. Above: *cinctipennis* (Butler); Haleakala. Below: *cinctipennis albistigma* (Warren); Nuuanu, Oahu.

Hostplant: *Chenopodium*.

Parasites: *Chaetogaedia monticola* (Bigot), *Frontina archippivora* Williston.

Unfortunately, the genitalia of the male type have been lost. They had been dissected some years ago and placed in a tube of preservative at the British Museum, but when I wished to study the dissection, it was found that the vial had been broken and no trace of the genitalia could be found.

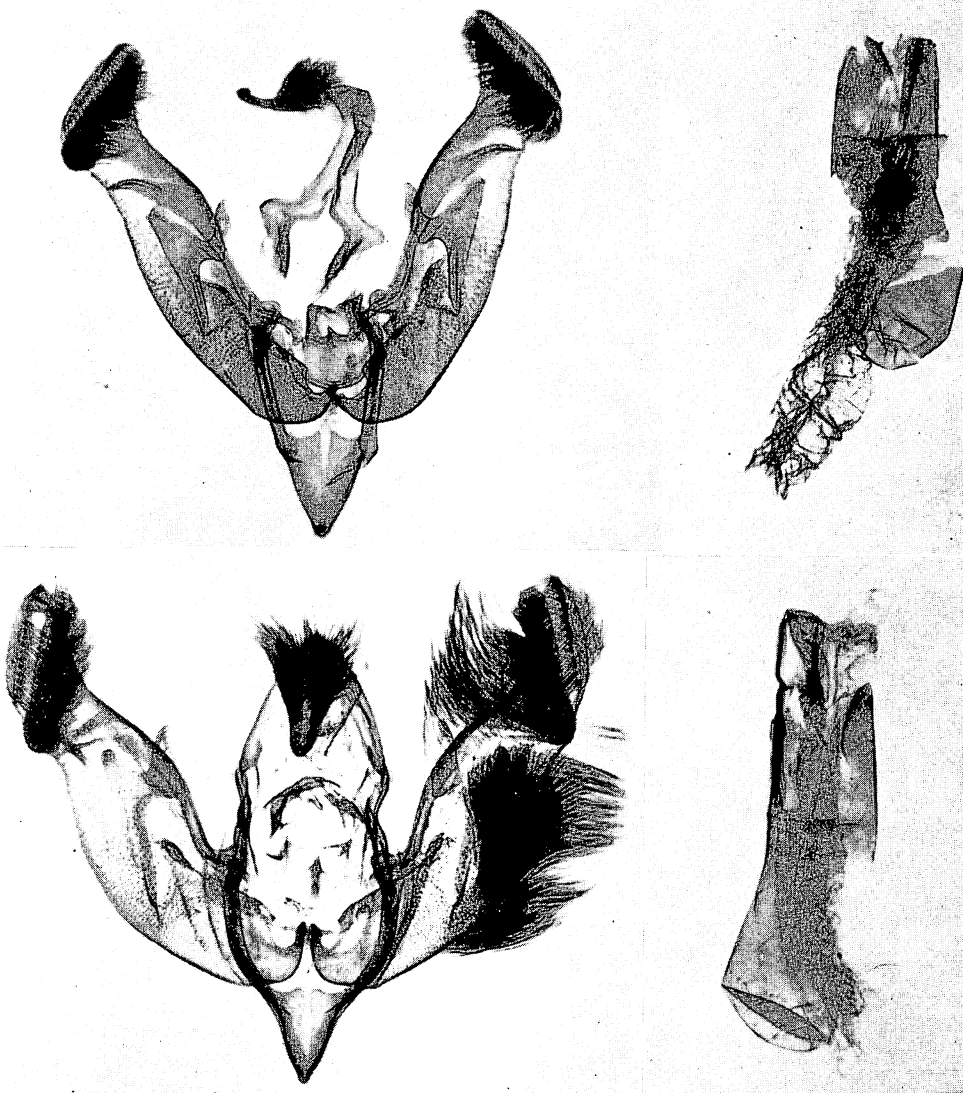


Figure 228—Male genitalia of *Peridroma*. Above: *coniolis rufata* (Warren); Kaholuamano, Kauai. Below: *neurogramma* (Meyrick), type from Kilauea, Hawaii.

***Peridroma coniotis rufata* (Warren), new combination** (figs. 222, 228, 233).

*Agrotis coniotis* "ab. 2" Hampson, 1903:426.

*Rhyacia conistis* (misspelling) "ab." *rufata* Warren, 1912:58.



Figure 229—Male genitalia of *Peridroma*. Above: *porphyrea* (Denis and Schiffermueller); Austria. Below: The type of *selenias* (Meyrick); Waimea Mts., Kauai.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet).  
Hostplant: Unknown.

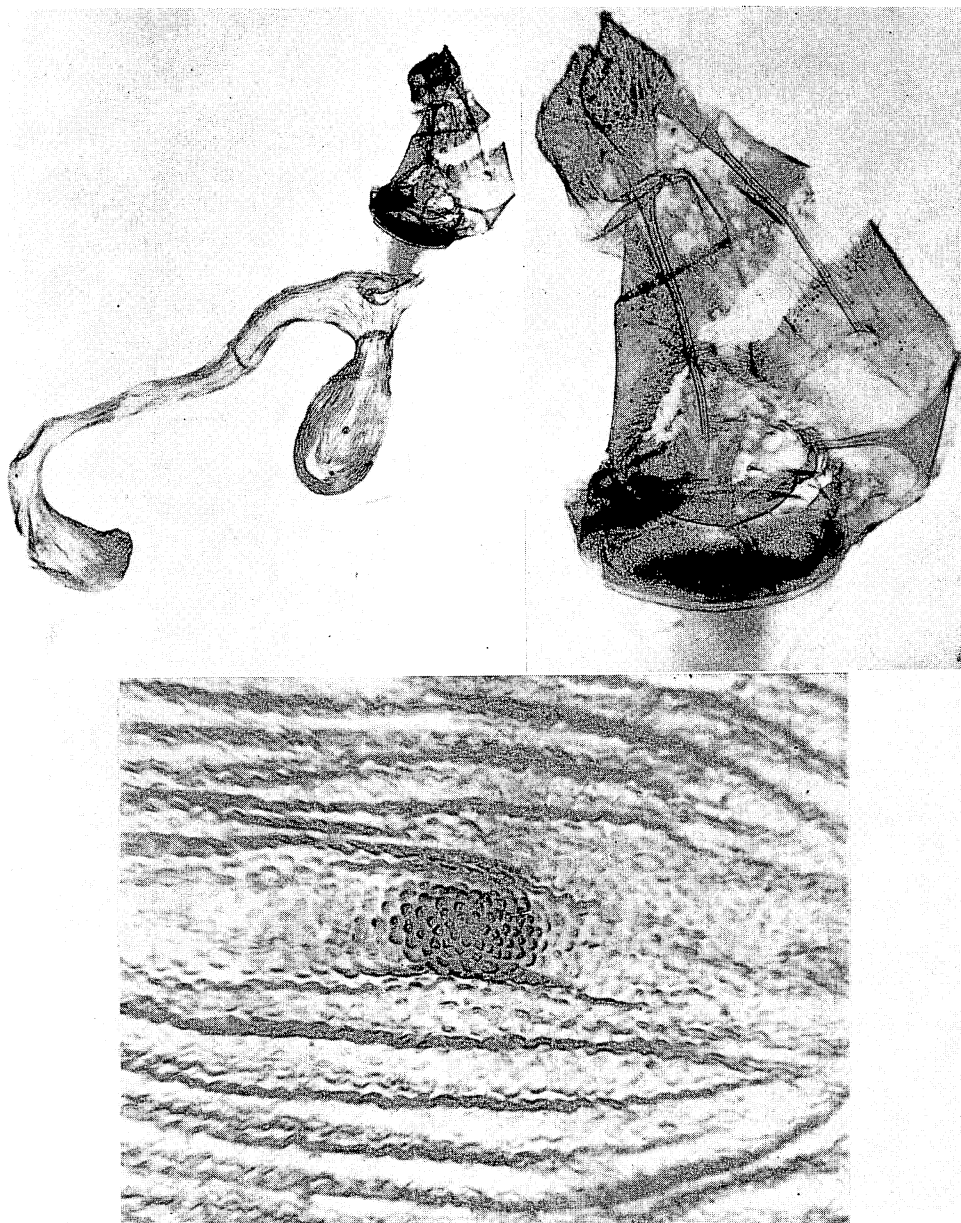


Figure 230—Female genitalia of *Peridroma albiorbis* (Warren), virgin lectotype; Kona, Hawaii; the small signum is enlarged below.

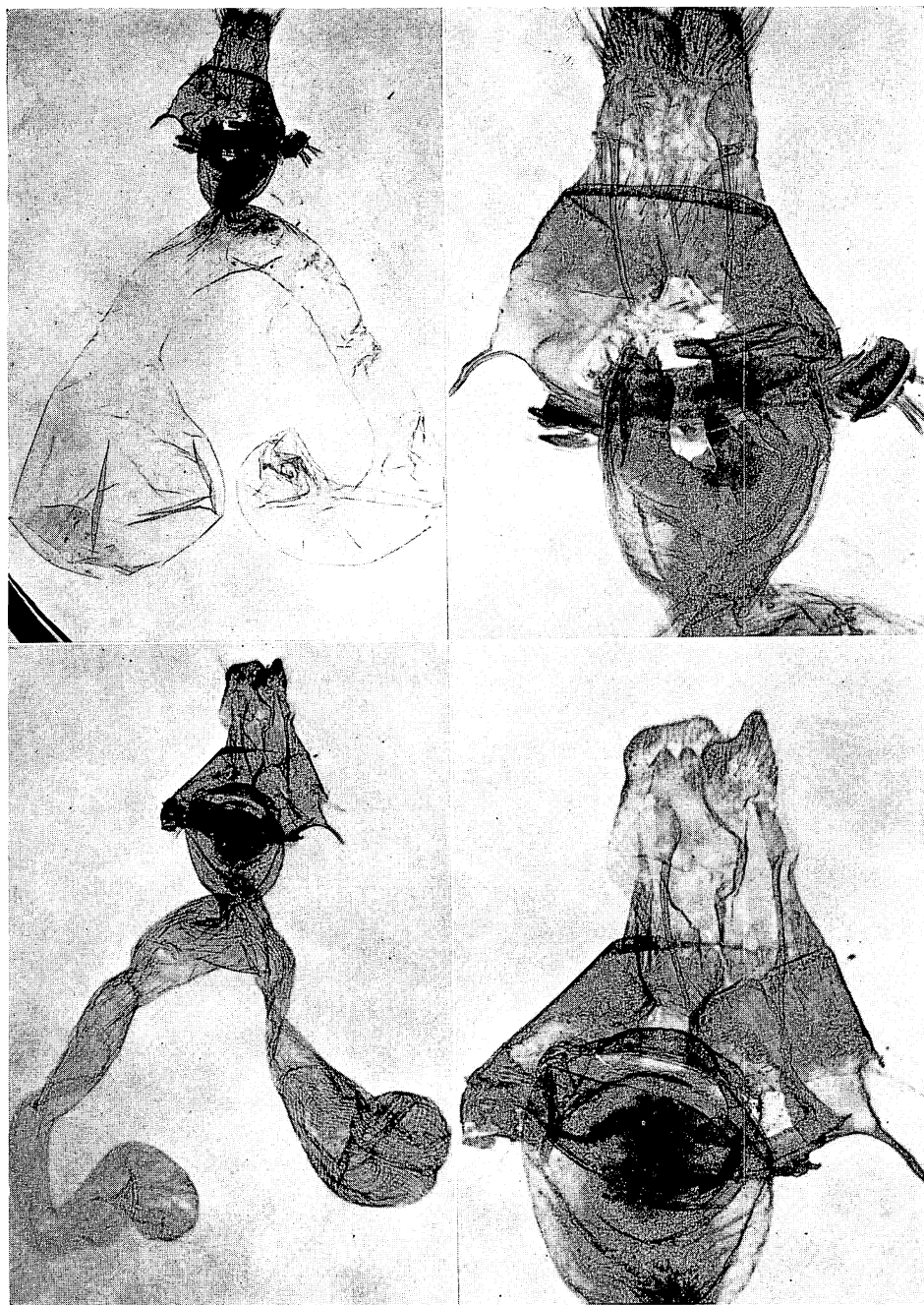


Figure 231—Female genitalia of *Peridroma*. Above: *cinctipennis* (Butler), type. Below: Lecto-type of *cinctipennis albistigma* (Warren); Honolulu, 1,500 feet.

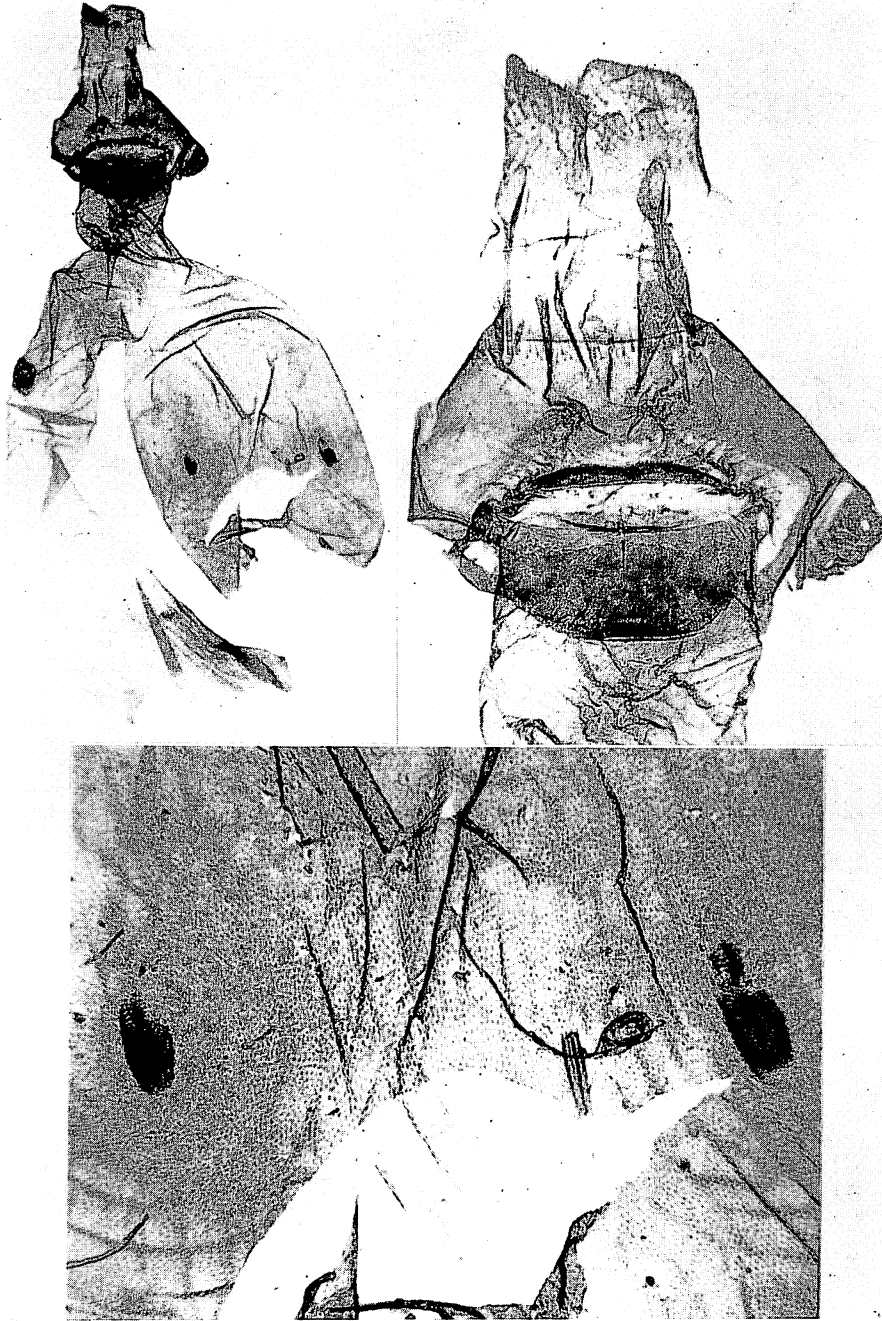


Figure 232—Female genitalia of *Peridroma coniotis* (Hampson); Waimea Mts., Kauai, 4,000 feet. This is a mated female; compare the bursa with that of the virgin *chersoloides* in figure 234.





Figure 233—Female genitalia of *Peridroma*. Above: *coniotis rufata* (Warren), lectotype; Waimea Mts., Kauai, 4,000 feet. Below: *neurogramma* (Meyrick); Kilauea, Hawaii.



***Peridroma neurogramma*** (Meyrick), **new combination** (figs. 225, 228, 233).

*Agrotis neurogramma* Meyrick, 1899:149, pl. 4, fig. 10. Hampson, 1903:415, pl. LXX, fig. 21.

*Rhyacia neurogramma* (Meyrick) Warren, 1912:57, pl. 7g.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

Although basically the color pattern is really not very different from such species as *selenias*, the pale scaling along the veins sets this species apart and gives it a distinctive appearance.

***Peridroma porphyrea*** (Denis and Schiffermueller), type of *Peridroma* (figs. 220, 225, 229, 235).

*Noctua porphyrea* Denis and Schiffermueller, 1775:83.

*Agrotis saucia* Huebner, 1807: fig. 378.

*Noctua margaritosa* Haworth, 1809:218 ("the pearly underwing").

*Lycophotia margaritosa* (Haworth) Hampson, 1903:536, fig. 92.

*Rhyacia saucia* form *margaritosa* (Haworth) Warren, 1912:61.

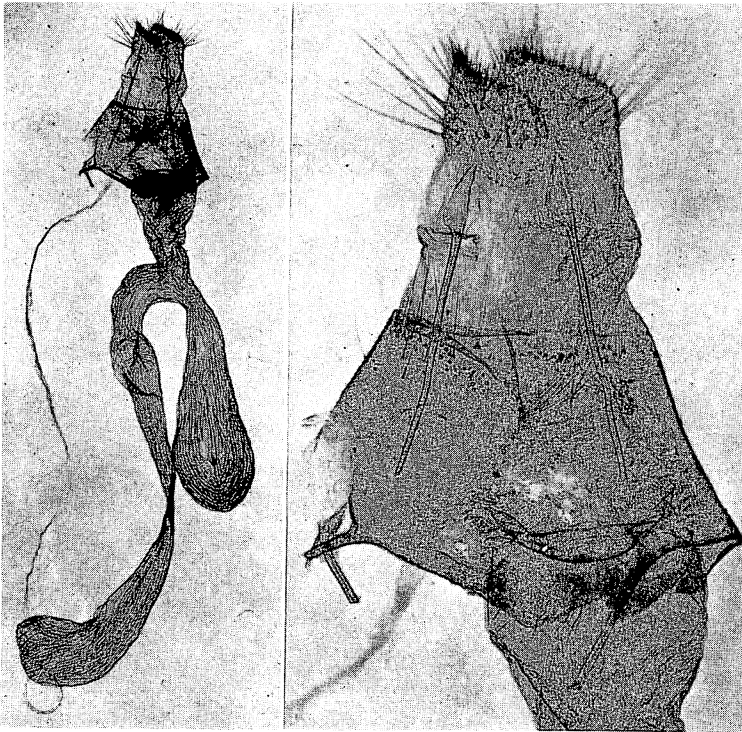


Figure 234—Female genitalia of a virgin *Peridroma chersotoides* (Butler); "Hawaii 87-7," Blackburn.

The variegated cutworm: Hawaiian name for caterpillar: "poko."

Kauai, Oahu, Maui, Hawaii, Laysan.

Immigrant; nearly cosmopolitan. First recorded from Hawaii by Meyrick (1899: 143) from specimens collected by Perkins, but possibly established in Hawaii long before that date, although, as Perkins remarks (1913:cxlv), it was not collected by Blackburn.

Hostplants: Various garden and farm crops, cabbage (head and Chinese), corn, *Datura*, orange, *Portulaca*, potato (foliage and tubers), *Sonchus*, sugarcane, tomato, *Xanthium*.

Parasites: *Euplectrus plathypenae* Howard, and probably *Archytas cirphis* Curran, *Chaetogaedia monticola* (Bigot), *Chelonus texanus* Cresson, *Eucelatoria armi-*

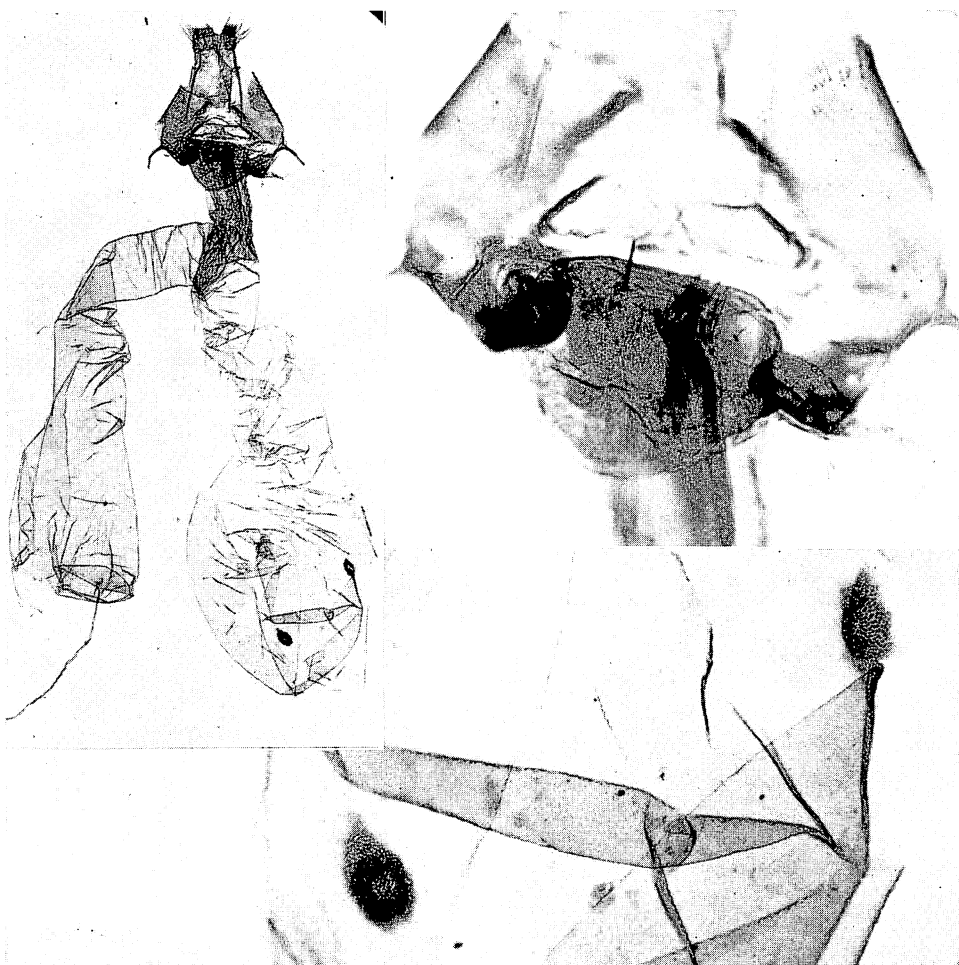


Figure 235—Female genitalia of *Peridroma porphyrea* (Denis and Schiffermueller); Waimea Mts., Kauai.

*gera* (Coquillett), *Hyposoter exiguae* (Viereck), *Meteorus laphygmae* Viereck, *Pseudamblyteles koebelei* (Swezey), *Pterocormus rufiventris* (Brullé).

Predator: *Calosoma blaptoides tehuacanum* (Lapouge).

The eggs are deposited in regular masses, often in regular rows on the surface of leaves or twigs, usually a large number in a mass, often several hundred. The egg is about .6 mm., hemispherical,

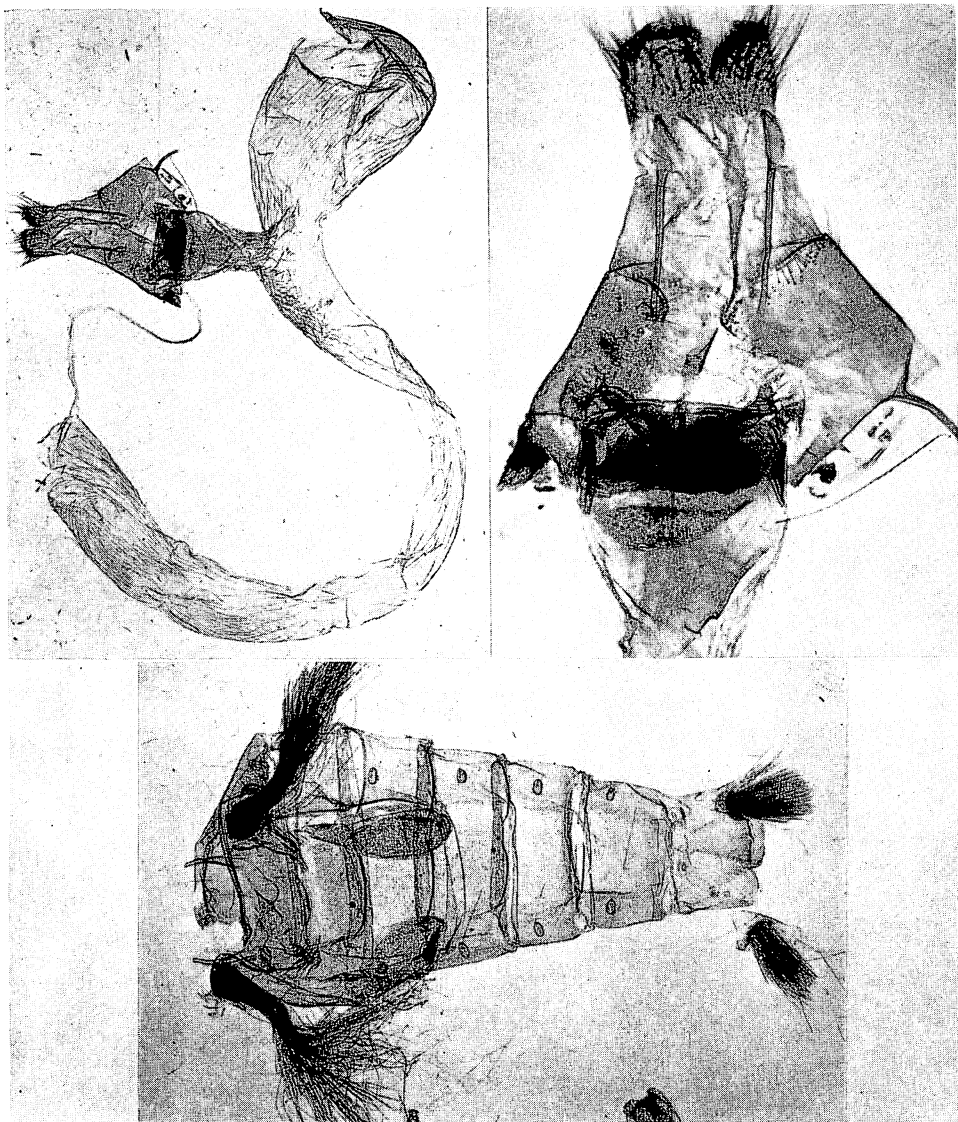


Figure 236—*Peridroma selenias* (Meyrick). Above: Female genitalia; Waimea Mts., Kauai, 4,000 feet. Below: A cleared abdomen of a male from Kauai, mounted in balsam, genitalia removed; note the large subbasal tufts and the pockets in the abdomen where they are stored in repose.

flattened on the surface in contact with leaf or twig. It is radiately ribbed from the upper pole, and has minute cross ribs between these. The young larvae are green with black heads. They molt five times before attaining their full growth, which takes about a month or a little more. (Swezey, 1909:22.)

The caterpillar, which has prolegs on abdominal segments three, four, five and six, and a "yellowish middorsal spot on metathorax and on abdominal segments 1 to 4" (Swezey, 1944:142). The pupa was described by Swezey (1909:22) as follows:

The full-grown caterpillar . . . is about 1.75 inches (40–45 mm.). It varies much in color. Head pale brown, reticulate with dark brown, a slight line upward from eyes, two curved vertical broad dark bands in front. Body brown, more or less generally mottled with darker and lighter brown and some yellowish; dorsal line pale yellowish, often broken into a series of yellowish patches on segments 4–7, (sometimes on segments 3–9); segment 12 mostly usually yellow dorsally on posterior part; a yellowish line below the spiracles, which are black. Tubercles and hairs very minute. In darker forms the browns are nearly black. There is a more or less irregularly interrupted blackish streak just above the line of spiracles. A subdorsal line consisting of blackish spots on each segment. On several of the segments there is a dorsal lozenge-shaped spot slightly darker than the general color, but not so dark as the blackish stripes. A blackish spot on outer side of each proleg.

The pupa is formed in the ground a few inches below the surface, or beneath trash. It is 19 mm. in length, and of a uniform medium brown color, its apex armed with two spines very close together, the basal half of each spine black, the tips white. The moth appears in two or three weeks.

It may become more abundant in lowland localities in the winter months.

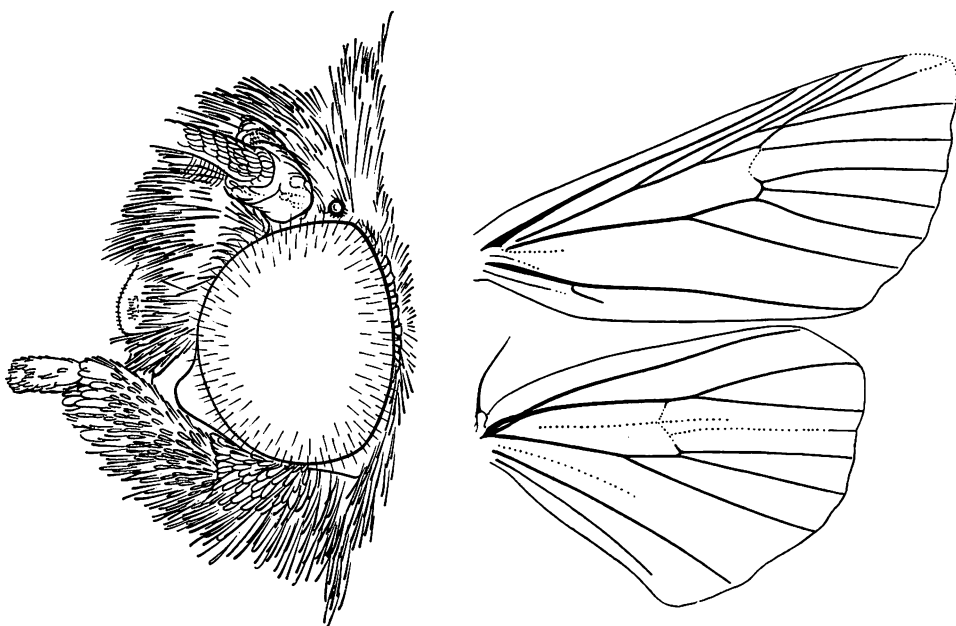


Figure 237—Head (left) and wing venation (right) of *Trichoclea postica* Smith.

***Peridroma selenias* (Meyrick), new combination** (figs. 223, 229, 236).

*Agrotis selenias* Meyrick, 1899:150. Hampson, 1903:425, pl. LXXXI, fig. 1.

*Rhyacia selenias* (Meyrick) Warren, 1912:58, pl. 7h.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet), Oahu, Hawaii.

Hostplant: Unknown.

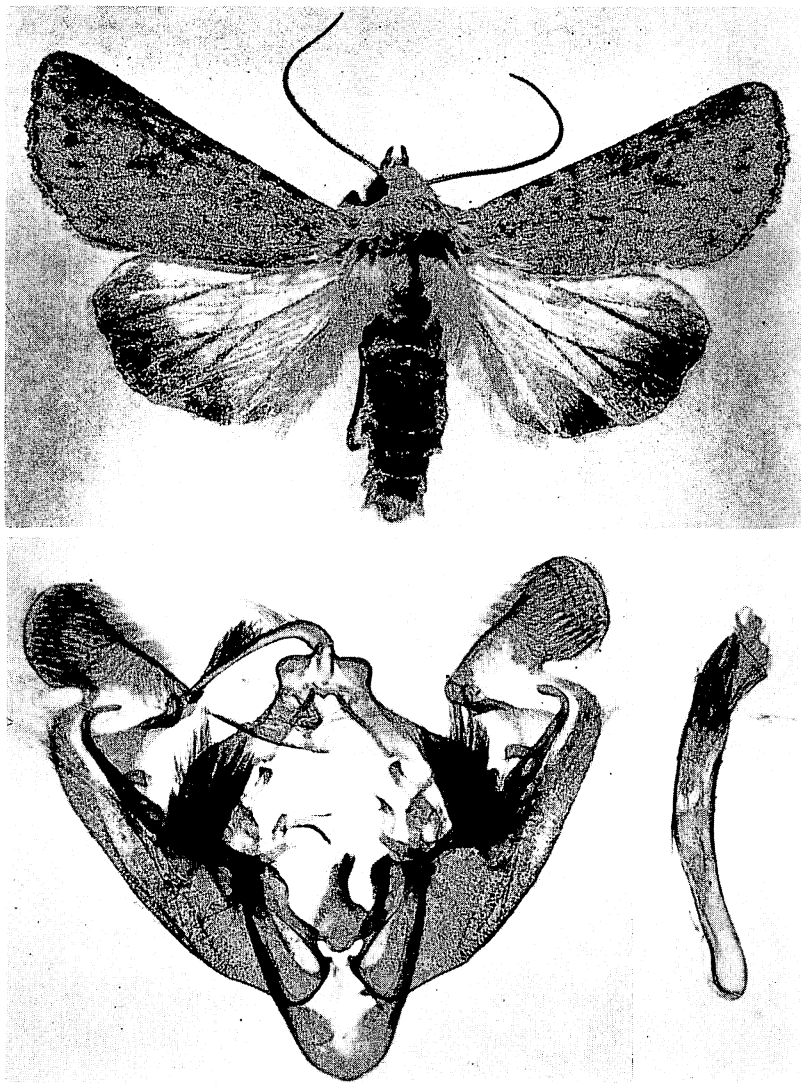


Figure 238—*Trichoclea postica* Smith; Iroquois Point, Oahu; expanse, 36 mm. Also male genitalia of an example from Denver, Colorado.

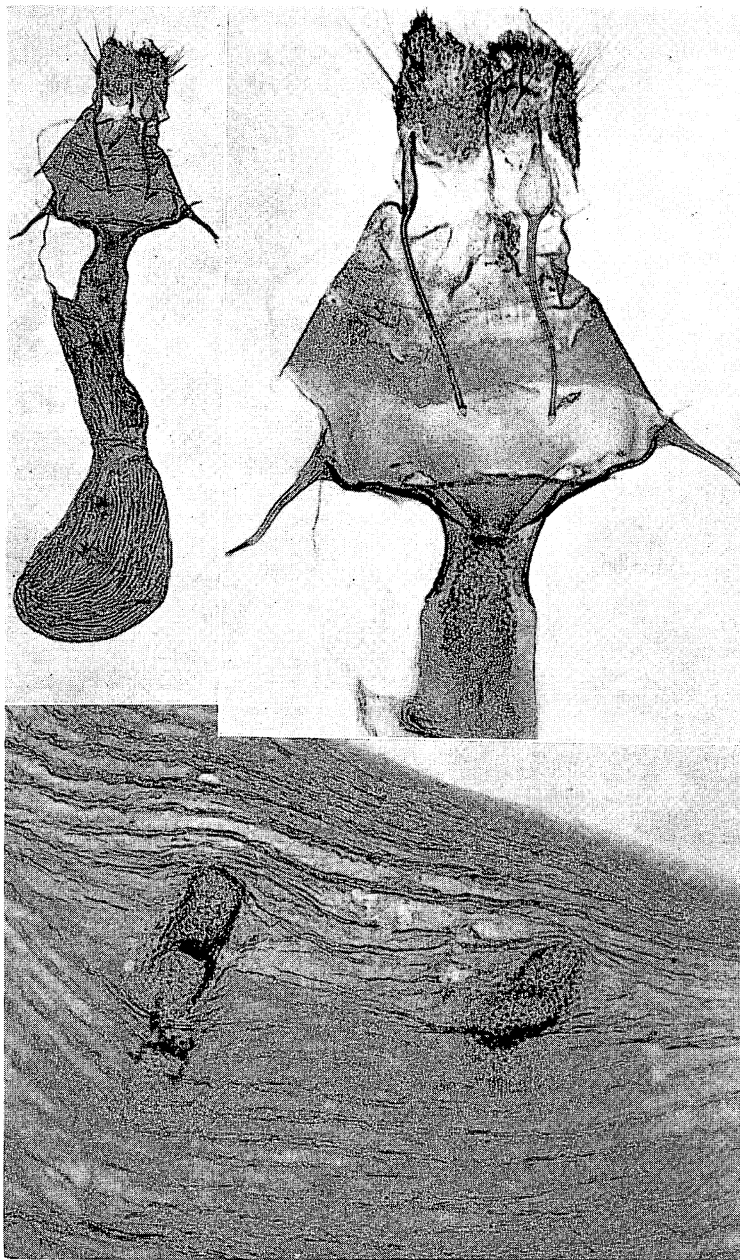


Figure 239—Female genitalia of *Trichoclea postica* Smith; specimen from Colorado.

## Subfamily HADENINAE

*Hadenides* Boisduval, 1840:113.

*Hadenidae* Herrich-Schaeffer, 1850:245. Guenée, 1852:14.

*Hadeninae* Hampson, 1905:1; 1918:383. Mosher, 1916:110.

Genus **TRICHOCLEA** Grote, 1883

**Trichoclea postica** Smith (figs. 237, 238, 239).

*Trichoclea postica* Smith, 1891:115, pl. 2, fig. 5.

Oahu.

Immigrant; described from Colorado and distributed to the Pacific Coast of the United States. First discovered in Hawaii in light trap catches made in the Pearl Harbor area in the autumn of 1947.

Hostplant: Perhaps this species will be found to feed upon a beach plant (an associated species feeds upon *Atriplex* in southern California), but its habits are at present unknown to me.

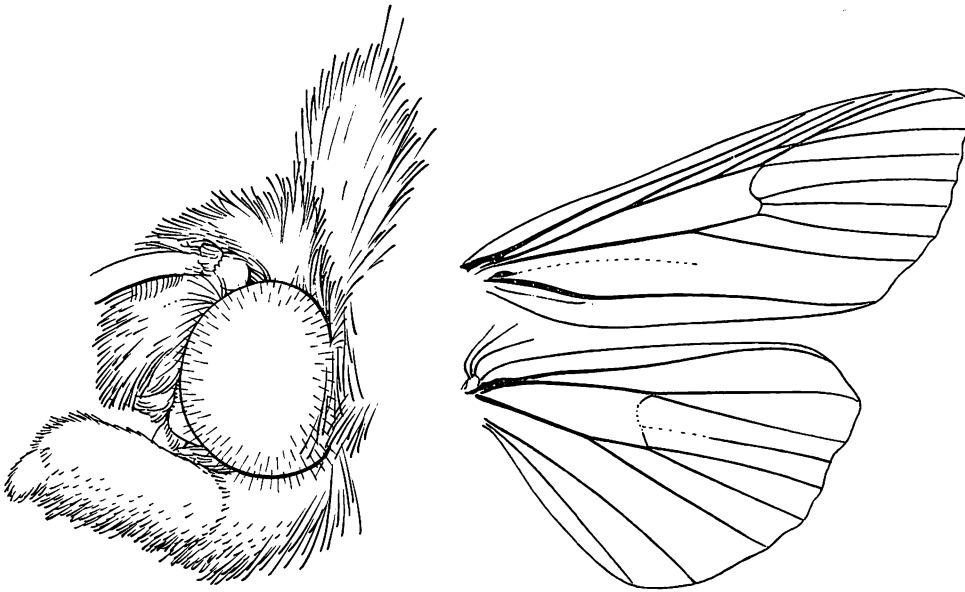


Figure 240—*Pseudaletia*. Head of male type of *dasuta* (Hampson) and wing venation of *unipuncta* (Haworth).



Genus **PSEUDALETIA** Franclemont, 1951:64

Considerable confusion has existed in the classification of this group. Franclemont (see his 1951:57 report), working at the United States National Museum, and I, working at the British Museum, independently arrived at the same conclusions, and we hope that we now have the species correctly arranged. The keys made by Meyrick and by Hampson are worthless.

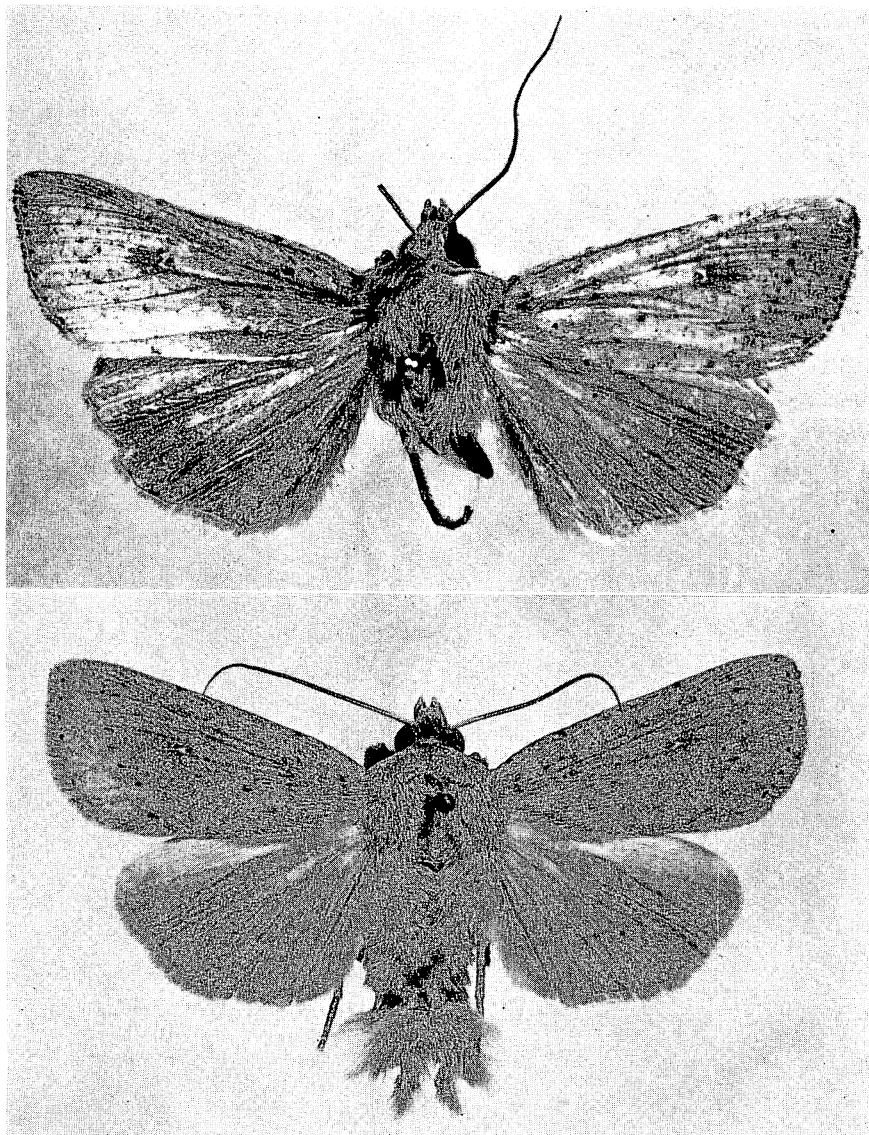


Figure 241—Above: *Pseudaletia amblycasis* (Meyrick), male type; Lanai, 2,000 feet; expanse, 40 mm. Below: Another male, reared from sugarcane; Koloa, Kauai; expanse, 41 mm.



This genus is known from North and South America, the Galapagos, the Palearctic Region and the Indo-Pacific. The largest concentration of species is in America. Perkins (1913:cxlvi), said that "*L. amblycasis*, even in dry localities, is not infrequently found on the lowlands in company with *L. unipuncta*. In the forest region it is much attracted by the flowers of *Metrosideros*, of which a small tree may yield hundreds of examples of this moth. When disturbed they fall to the ground and make no attempt to fly, being gorged with the copious nectar of the flowers. The moth has great powers of flight and we have known it attracted to the lights of an interisland steamer, when this was in midchannel."

#### KEY TO THE SPECIES OF PSEUDALETIA FOUND IN HAWAII

1. Lower surface of hind wings in male (only the male holotype is known) with dense, rough, hair-like, yellowish scales over most of basal half, the hairs bidentate at apices, the excessive hair very conspicuous to unaided eyes and mat-like in appearance; medial lines on lower surfaces of both fore and hind wings conspicuous; (extraordinarily like *unipuncta*, but hind wings concolorous above and veins not conspicuously dark, and, of course, this has the dense mat of hair beneath hind wing) ..... ***dasuta*** (Hampson).  
 Not such species; lower surfaces of hind wings of male not so conspicuously coarse-hairy, at most finely hirsute ..... 2

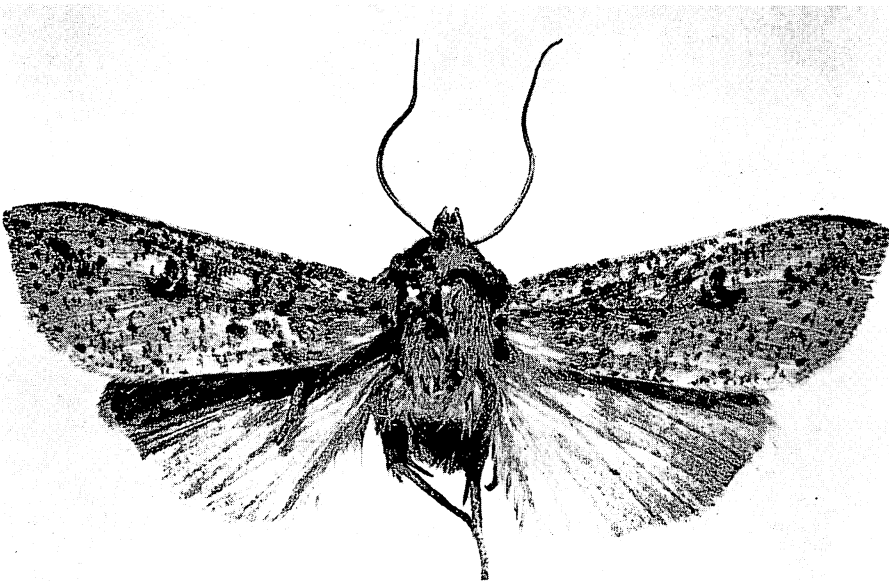


Figure 242—*Pseudaletia dasuta* (Hampson), male type; Kona, 4,000 feet; expanse, 41 mm.

- 2 (1). Hind wings broadly darkened along outer margins, veins conspicuously dark-colored and standing out boldly; the dark macula on under side of discocellulars usually rather conspicuous from upper side of hind wing, as in figure 247 . . . . . **unipuncta** (Haworth).

Hind wings more opaque and veins never standing out in sharp contrast; never with a dark mark on discocellulars visible from dorsum . . . . . 3

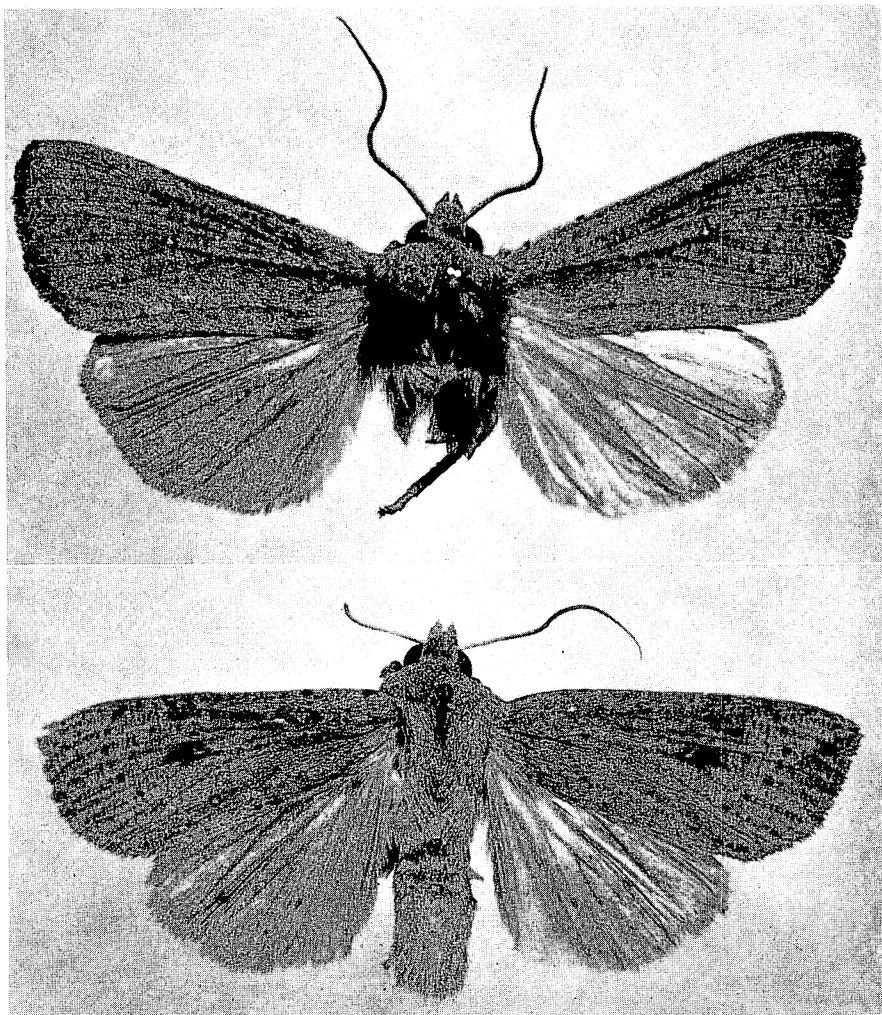


Figure 243—*Pseudaletia macrosaris* (Meyrick). Above: The male type of the synonym *pyrrhias* Meyrick; Waimea Mts., Kauai, 4,000 feet; expanse, 41 mm. Below: An example from Hamakua, Hawaii; expanse, 45 mm.

3(2). Dark dots marking terminal lines in fore wings rather strong and well-defined; valves of male genitalia as in figure 245.....**amblycasis** (Meyrick).

Dark dots marking terminal line in fore wings very small or obsolescent; male genital valves as in figure 246  
.....**macrosaris** (Meyrick).



Figure 244—*Pseudaletia macrosaris* (Meyrick). Above: The male type; Kona, Hawaii, 5,000 feet; expanse, 36 mm. Below: The type of the synonym *typhlodes* Meyrick; Olaa, Hawaii; expanse, 35.5 mm.

***Pseudaletia amblycasis* (Meyrick) (figs. 241, 245, 249).**

*Leucania amblycasis* Meyrick, 1899:141.

*Cirphis amblycasis* (Meyrick) Hampson, 1905:495, pl. XCI, fig. 30.

*Hyphilare amblycasis* (Meyrick) Warren, 1913:91, pl. 11k.

*Aletia amblycasis* (Meyrick) Meyrick, 1928:92.

*Pseudaletia amblycasis* (Meyrick) Franclemont, 1951:64.

Endemic. Kauai, Oahu, Molokai, Maui, Lanai (type locality: 2,000 feet), Hawaii.

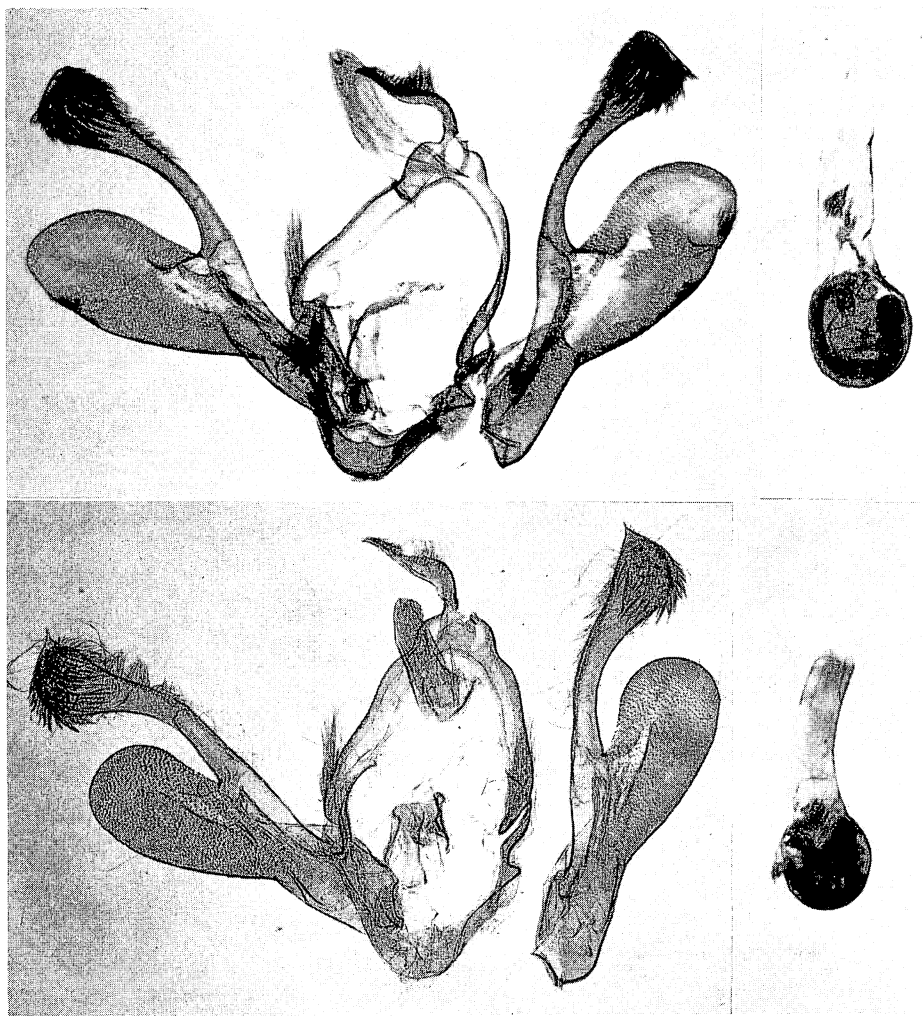


Figure 245—Male genitalia of *Pseudaletia*. Above: The type of *amblycasis* (Meyrick); Lanai, 2,000 feet. Below: The type of *dasuta* (Hampson); Kona, Hawaii, 4,000 feet.

Hostplants: grasses, bunch grass, sugarcane; the adults have been reported as common and feeding upon the blossoms of *Metrosideros*.

The type of this species does not have much indication of reddish scaling, but other examples are quite conspicuously reddish, and the color cannot be used as a key character. It is possible that the species is not as widely distributed as the published record would indicate, but I have not had an opportunity to study series of specimens from the various islands.

Swezey's observations (1909:10-11) on this species are as follows:

I have usually found the caterpillars of this moth feeding on various grasses of the lower lands; but I have also found a few of them along with *C. unipuncta* and other caterpillars in the higher



Figure 246—Male genitalia of *Pseudaletia*. Above: The type of *macrosaris* (Meyrick); Kona, Hawaii, 5,000 feet. Below: Type of the synonym *pyrrhias* Meyrick; Waimea Mts., Kauai, 4,000 feet.

cane fields of the sugar plantations of the Hamakua and Hilo districts of Hawaii. I have never found them numerous enough of themselves to be injurious.

The full-grown caterpillar is about 38 mm. It is usually cream colored with pale brownish mottlings; a more or less distinct fuscous mid-dorsal stripe, pale-centered; a wide dark fuscous sub-dorsal stripe, concave on upper edge in each segment, connected by transverse bar on segment 12; a wide supraspiracular stripe of fuscous mottlings, below this a pale yellowish line; prolegs with dark fuscous spot on outer side; head very pale brownish with minute fuscous reticulation, vertical fuscous spot in middle of paraclypeus, a wide fuscous border to inner edge of each cranial lobe; eyes black, a fuscous line extends upwards, and another obliquely backward from them; cervical shield much spotted with dark fuscous, transversed by a median white line and a sub-dorsal white line on each side; spiracles oval, black; tubercles minute, black; a roundish black spot on segments 3 and 4 a little above line of spiracles.

The caterpillars become full-grown in about a month from the hatching of the eggs. Like *unipuncta*, they may often be found on their foodplant in the daytime; in cane, hiding behind the leaf-sheaths.

Pupation takes place in an earthen cell a little below the surface of the ground, or beneath stones or rubbish. The pupa is about 19 mm. long by 5 mm. thick; medium brown, darker on the back, eyes nearly black; a row of about a dozen pits on dorsal side at base of abdominal segments 5, 6 and 7; apex of abdomen pointing a little ventrally, with two slightly diverging, pale spines, dark at base, curved ventrally and hooked at tip, a curved hooked bristle a little dorsally, and another a little laterally from each of these terminal spines. The moth emerges from the pupa in about two weeks.

***Pseudaletia dasuta* (Hampson) (figs. 240, 242, 245).**

*Cirphis dasuta* Hampson, 1905:493, fig. 154.

*Hyphilara dasuta* (Hampson) Warren, 1913:91, pl. 11k.

*Aletia dasuta* (Hampson) Meyrick, 1928:92.

*Pseudaletia dasuta* (Hampson) Franclemont, 1951:64.

Endemic. Hawaii (type locality: Kona, 4,000 feet).

Hostplant: Unknown.

This species is known only from the unique male holotype. Dr. Swezey has expressed the opinion that it might be *unipuncta*, but this is a very distinct species. The densely hairy undersides of the hind wings is unusual and noteworthy.

***Pseudaletia macrosaris* (Meyrick) (figs. 243, 244, 246).**

*Leucania macrosaris* Meyrick, 1899:140.

*Cirphis macrosaris* (Meyrick) Hampson, 1905:494, fig. 155.

*Hyphilara macrosaris* (Meyrick) Warren, 1913:91.

*Aletia macrosaris* (Meyrick) Meyrick, 1928:92.

*Pseudaletia macrosaris* (Meyrick) Franclemont, 1951:64.

*Leucania pyrrhias* Meyrick, 1899:141, pl. 4, fig. 3.

*Cirphis pyrrhias* (Meyrick) Hampson, 1905:494, pl. XCI, fig. 28.

*Hyphilara pyrrhias* (Meyrick) Warren, 1913:91, pl. 11k.

*Aletia pyrrhias* (Meyrick) Meyrick, 1928:92.

*Pseudaletia pyrrhias* (Meyrick) Franclemont, 1951:64. **New synonym.**

*Leucania typhlodes* Meyrick, 1899:141.

*Cirphis typhlodes* (Meyrick) Hampson, 1905:495, pl. XCI, fig. 29.

*Hyphilara typhlodes* (Meyrick) Warren, 1913:91, pl. 11k.

*Aletia typhlodes* (Meyrick) Meyrick, 1928:92.

*Pseudaletia typhlodes* (Meyrick) Franclemont, 1951:64. **New synonym.**

Endemic. Kauai, Oahu, Molokai, Hawaii (type locality: Kona, 5,000 feet).

Hostplants: Principally the sedge, *Baumea meyenii*, but also on *Paspalum conjugatum* (Hilo grass), bunchgrass and sugarcane on occasion.

Parasite: *Chaetogaedia monticola* (Bigot).

In *Fauna Hawaiiensis*, Meyrick gave the type locality of *macrosaris* as Kona, 1,500 feet, but the type label states that it was taken at 5,000 feet. The type of *typhlodes* came from Olaa, Hawaii, and the type of *pyrrhias* from the Waimea Mountains, Kauai, 4,000 feet.

This is a somewhat variable species which has caused considerable confusion in our literature. Following a study of the genitalia and the types at the British Museum, I have concluded that *pyrrhias* and *typhlodes* are not specifically distinct from *macrosaris*.

This is a native moth usually living in the native forest regions above cultivated lands. The caterpillars normally feed on grasses, commonly Hilo grass; and on sedges, particularly *Baumea meyenii*, a large equitant-leaved species growing on the mountain ridges at elevations of 1,000 feet and more. The caterpillar may often be found on the leaves of this plant or hiding in the dead leaves and trash at its base. I have observed a few of them in the higher parts of the sugar cane plantations of the Hamakua and Hilo districts of Hawaii, where they were feeding on the young cane along with army worms and other cutworms. They have the habit of hiding behind the leaf-sheaths of the cane, in the daytime, as the caterpillars of *unipuncta* often do.

I once found about a dozen eggs of this moth in a row on a leaf of Hilo grass (*Paspalum conjugatum*). They were white, spherical, with a faint microscopical reticulation, about 1 mm. in diameter, distinctly larger than eggs of *Feltia dislocata*. The larvae from these eggs became full-grown in about a month. They molted five (possibly six) times at intervals of three to five days. The pupal stage occupied about three weeks.

The full-grown caterpillar is 42–45 mm.; olivaceous, with faint rosy tinge in places; head reticulated with brown; cervical shield traversed longitudinally by three whitish lines bordered on both sides by blackish; the whitish lines are faintly continuous on the body, the mid-dorsal one somewhat interruptedly bordered with brownish fuscous, each lateral one forms the lower boundary of an interrupted dark, brownish-fuscous subdorsal stripe; just above line of spiracles a much interrupted wide brownish-fuscous stripe, more distinct posteriorly and extending onto posterior proleg; other prolegs with a large blackish spot on the side; tubercles forming two rows of black dorsal dots; other tubercles not conspicuous; hairs short, pale; spiracles oval, black; a black dot in line with them on segments 3 and 4. Younger caterpillars are often paler; and in some of them the dark stripes are more conspicuous.

The pupa is formed a little beneath the surface of the soil, or under trash. It is about 22 mm. long by 6.5 mm. thick; medium reddish brown, a little darker on the back; near basal dorsal margin of abdominal segments 5, 6 and 7 is a transverse row of about twenty pits situated in a black line; apex of abdomen very blunt, cremaster slightly projecting near dorsal side, with two slender, slightly diverging, pale spines, black at base, curved ventrally and hooked at tip; a curved, hooked bristle a little dorsally, and another a little laterally from each of these spines; wing-cases, etc. extend to apex of fourth abdominal segment. (Swezey, 1909:1–13.)

### ***Pseudaletia unipuncta* (Haworth) (figs. 240, 247, 248, 249).**

*Noctua unipuncta* Haworth, 1809:174.

*Leucania extranea* Guenée, Butler, 1880:7. Butler, 1882:32.

*Cirphis unipuncta* (Haworth) Hampson, 1905:547.

*Heliophila unipuncta* (Haworth), of authors.

*Sideridis unipuncta* (Haworth) Warren, 1913:96.

*Pseudaletia unipuncta* (Haworth) Franclemont, 1951:65, figs. 10, 10a, 11, 11a, 33.

Crumb, 1956:149, larva.

The army worm; Hawaiian name for caterpillars: "peelua."

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii, Lisiansky.

Immigrant. Widespread, but many of the records under this name are incorrect and apply to other, closely similar species which are frequently misidentified and confused with this species. Authentic material has been reported from the United States, Canada, Mexico, North Atlantic islands, southern Europe to England.

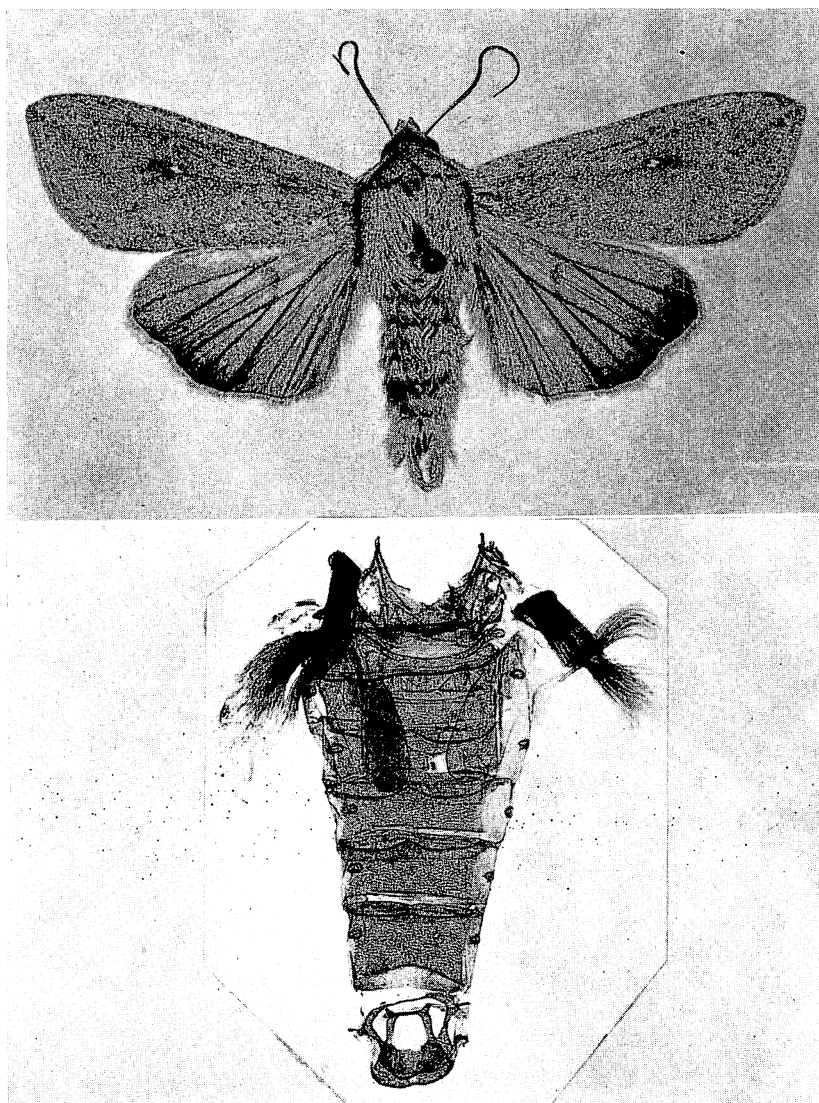


Figure 247—*Pseudaletia unipuncta* (Haworth). Above: A male from Honolulu; expanse, 46 mm. Below: The cleared, balsam-mounted abdomen of the male type, genitalia removed; note the large pockets in the abdomen in which the basal hair-tufts are stored in repose.



First recorded from Hawaii by Butler (1880:7) from specimens collected by Blackburn.

Hostplants: Grasses, corn, *Cyperus rotundus* (nutgrass), sugarcane.

Parasites: *Apanteles marginiventris* (Cresson), *Archytas cirphis* Curran, *Chaetogaedia monticola* (Bigot), *Chelonus texanus* Cresson, *Eucelatoria armigera* (Coquillett), *Euplectrus plathypenae* Howard, *Frontina archippivora* (Williston), *Hyposoter exiguae* (Viereck), *Meteorus laphygmae* Viereck, *Pristomerus appalachianus* (Viereck), *Pseudamblyteles koebelei* (Swezey), *Pterocormus rufiventris* (Bruellé), *Trichogramma minutum* Riley, an epidemic wilt disease.

Predators: *Calosoma blaptoides tehuacanum* (Lapouge), mynah bird, *Polistes* species.

Swezey's report (1909:7-9) on the species is as follows:

In these islands, they usually occur in the lowlands and grassy regions; and when abundant in sugar cane fields it is those fields which adjoin fields of grass, or which have more or less grassy gulches in them, or in fields which have been recently planted on land that had lain fallow and had grown up with grass and weeds, or had been in pasture for a time. Although the moths breed more or less the year round, they are more prolific, or breed more favorably during the so-called winter months, November to April. In many districts there is more rain during these months and growths of grass occur favorable for the feeding of the caterpillars. At this time of the year, in fields of young cane situated as above designated, they often are present in sufficient numbers to severely check the growth of the cane. They, in connection with other cut worms, sometimes strip the leaves of the cane, leaving nothing but midribs. This may be only in certain parts of the field, or it may be over a considerable area of it. As the caterpillars feed for about three weeks or a month, while getting their growth, the cane will be checked for this length of time; but after the caterpillars of one brood have become full-grown and cease feeding, there will be a period of a few weeks before the next brood, so that the cane will have a chance of recovery, and the larger it gets the better is it able to withstand further attacks.

The egg of the army worm is spherical, smooth, white, and opaque when first laid, becoming faintly iridescent and more sordid before hatching. Its average diameter is 0.6 mm. The eggs are usually placed at the base of the leaves or thrust in behind the leaf sheath, but may often be deposited amongst trash or debris as well. The eggs are glued on to the objects, wherever they are deposited, and are commonly in rows of 15 to 20; but sometimes they are as few as 2 or 3, and

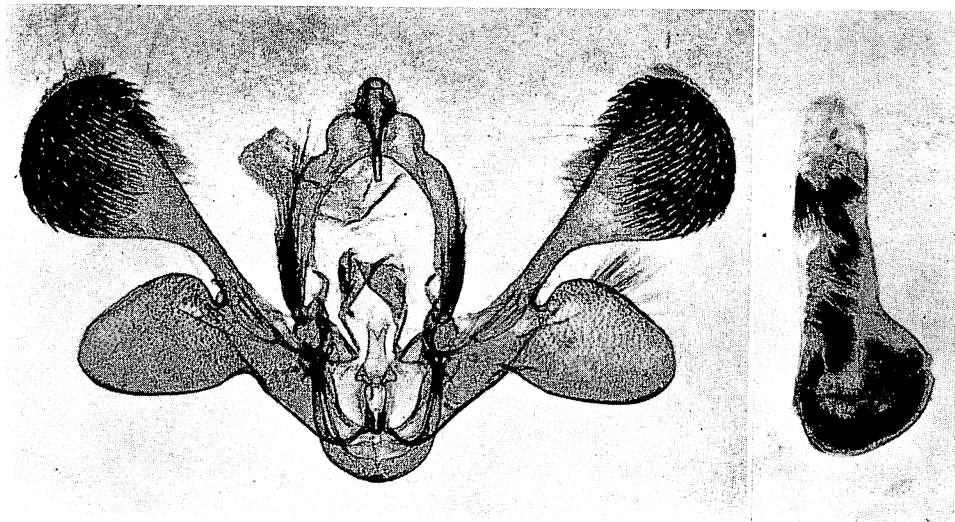


Figure 248—Male genitalia of the type of *Pseudaletia unipuncta* (Haworth).

again as many as nearly a hundred may be in one batch. The moths deposit their eggs in the early part of the night, often before dark sometimes. One female may deposit several hundred eggs (500-700) and may occupy two or more evenings so doing.

The eggs hatch in a week or ten days, depending on the temperature. The young caterpillars first crawl by a looping motion on account of the fact that the first and second pairs of abdominal prolegs are rudimentary. After the first molt only the first pair are rudimentary, and after the second molt all prolegs are functional and the caterpillar crawls in the normal manner. There are five molts at intervals of three to six days, and the growing period is thus about three to four weeks, depending on the temperature. The caterpillars usually feed on the plants at night-time and hide during the day beneath leaves or trash on the surface of the ground, or in the soil a little below the surface, or sometimes even remain on the plant and feed more or less or hide in a fold of leaf or behind a leaf sheath or other convenient place. Those feeding on the leaves in the daytime drop to the ground on the slightest disturbance and coil up, remaining motionless for a time. The feeding of the army worm is not like some of the cutworms in that it feeds on the leaves instead of eating the stem of a plant and thus cutting it off at or near the surface of the ground. The evidences of their feeding on sugar cane are easily detected; the lower leaves of the young cane-shoots being notched and ragged where they have eaten the blade of the leaf, and when numerous, in fact the blades of the leaves [may be] entirely eaten away, leaving nothing but the hard midribs.

The full-grown caterpillar . . . is 35-40 mm. long, or about one and one-half inches. General color greenish brown with longitudinal blackish stripes on back and sides, much paler below. The stripes are as follows: a wide, pale blackish stripe on the back with an interrupted white line in the middle; outside of this is a narrow pinkish brown stripe; then next a still wider blackish stripe darker along its lower edge, which contains the black oval spiracles, or breathing pores; below this is another pinkish brown stripe having whitish lines on each edge. The head is pale brown, each lobe with a network of darker brown and running up and down in front are two blackish bands diverging below. First segment behind the head nearly all brown dorsally. A dark brown spot on outer side of each proleg. Hairs small, situated in inconspicuous tubercles.

The coloration varies somewhat and the stripes are sometimes less distinct. The younger stages are colored about the same, often paler, and sometimes nearly black.

When full-grown, the caterpillar burrows into the soil and at a depth of two to four inches

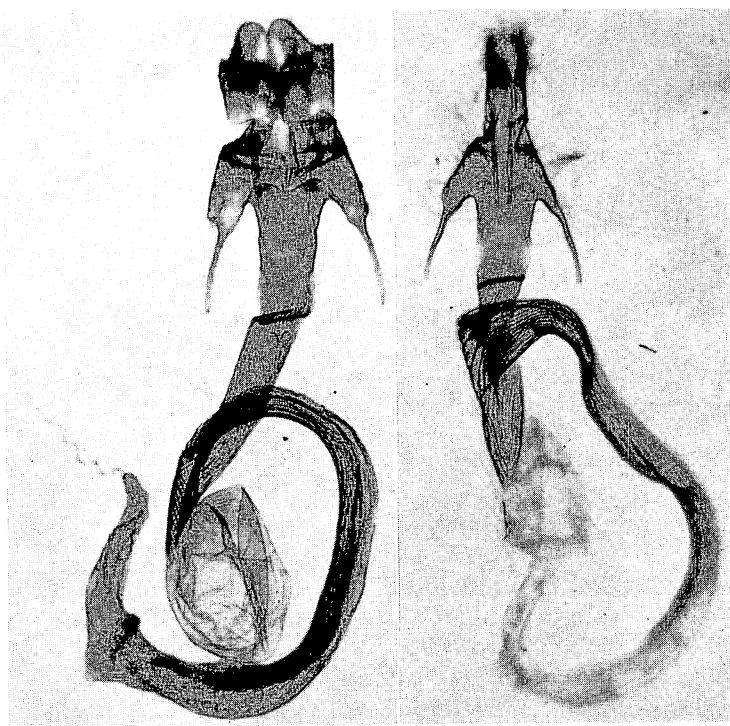


Figure 249—Female genitalia of *Pseudaletia*. Left: *amblycasis* (Meyrick); Haleakala, Maui. Right: *unipuncta* (Haworth); Mexico.

constructs an oval earthen cell, within which after a few days it transforms to the pupa . . . The pupa is of a shiny dark brown color, about 18 mm. long and 4.5 mm. thick, rounded at anterior end and tapering posteriorly to a blunt point which is armed with two nearly straight parallel spines, hooked at the tip, and placed near together. There are four other slender hooked bristles, one lateral and another a little dorsal of each of the larger spines. . . . The wing-cases terminate roundedly at the apex of the fourth abdominal segment. On the bases of abdominal segments 5, 6 and 7 is a dorsal black line containing a row of 12-20 pits. These segments are movable.

The moth emerges from the pupa in about ten days to two weeks. It makes its way above the surface, and, clinging to some object, its soft wings soon become expanded and dried, and the moth is fully matured, after a period of from six to eight weeks, or sometimes more, depending upon the temperature.

Swezey (1944:141-142) also noted that the larva has prolegs on abdominal segments 3, 4, 5 and 6, and "Lobes of head testaceous with brown meshes; wide dorsal area pale with a mottling of light brown and some fuscous, and a middorsal longitudinal white line, the outer margins bordered with a white line; also white lines bordering the outer margins of the dorsal area; spiracles black, at the lower margin of a longitudinal fuscous stripe which is somewhat interrupted segmentally."

This is the common armyworm, and it and species of similar habits may, during sporadic outbreaks of extreme abundance, cause considerable damage to grasses.

Following an announcement of the outbreak of armyworm in an English farming area, I was once asked by an alarmed newspaper reporter if armyworm were contagious!

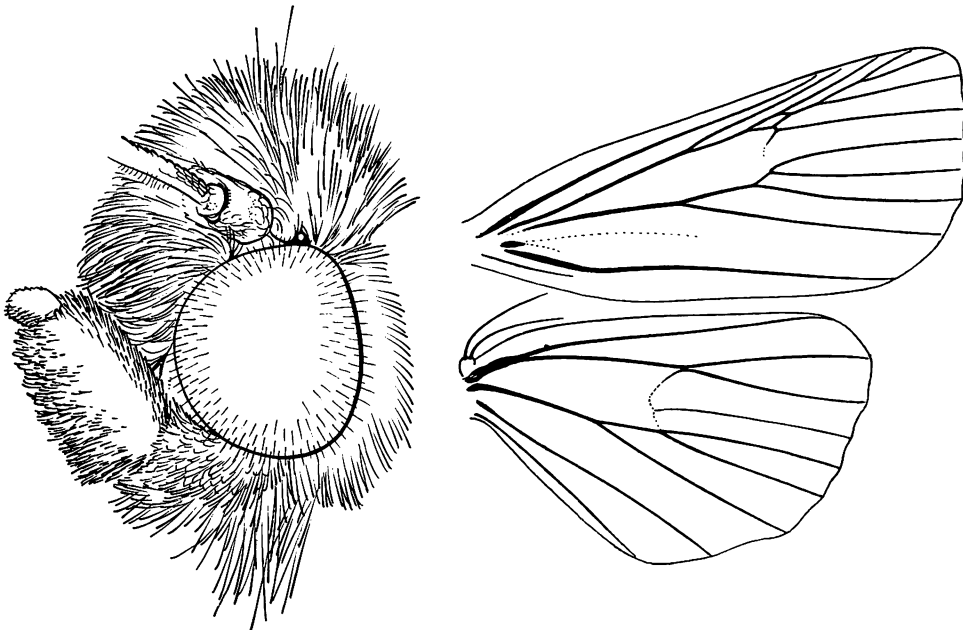


Figure 250—Head (left) and wing venation (right) of *Haliophyle compsias* (Meyrick). This example has veins 7, 8 and 9 in the fore wings coalesced at the areole. Examples of other species studied have vein 7 not so coalescent, but it arises independently from the areole. Both wings of this example are similar.

Genus **HALIOPHYLE** Warren, 1912:76

Although this genus was erected for a group of endemic Hawaiian moths, it has never been used in Hawaii. Perhaps this is because no library in Hawaii owned a copy of the great Seitz work, *The Macrolepidoptera of the World*, in which the description occurs. No copy of this all-important book was available in Hawaii until I personally purchased a copy. It not only contains the details concerning

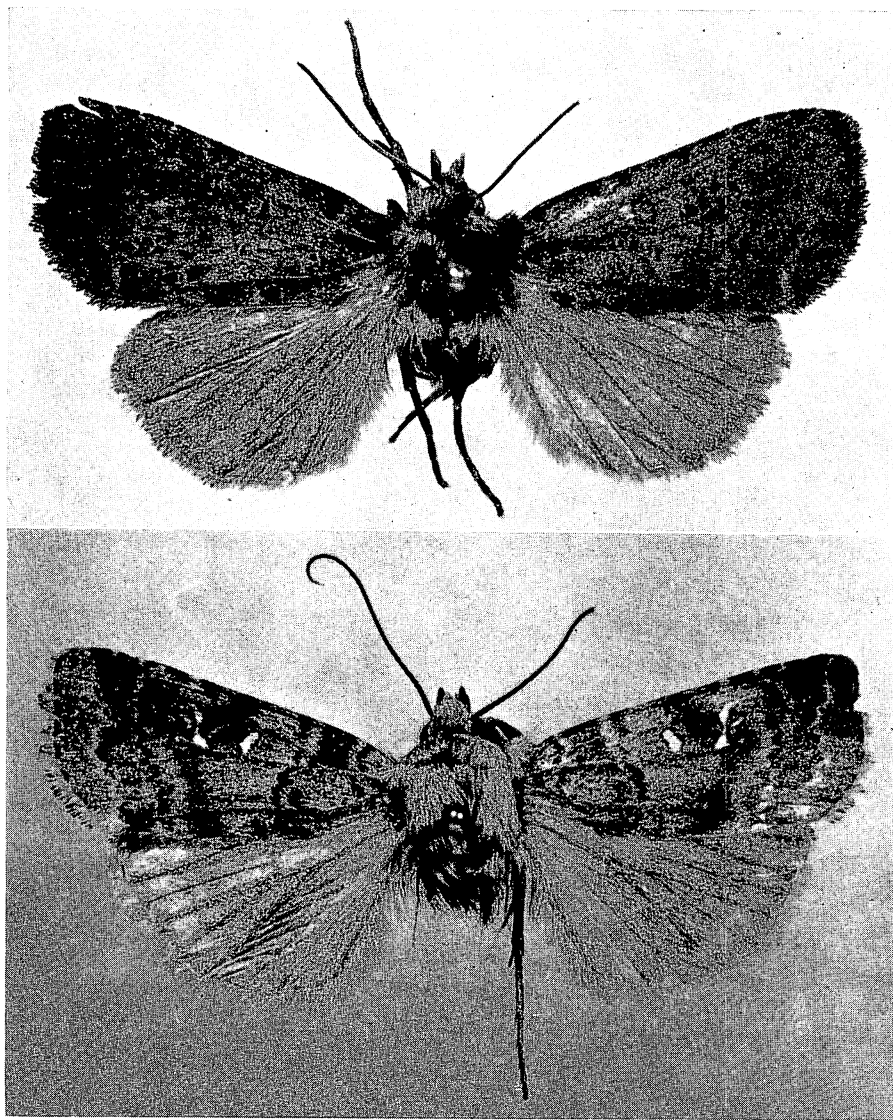


Figure 251—Above: *Haliophyle anthracias* (Meyrick), type male; Haleakala, Maui, 9,000 feet; expanse, 36 mm. Below: Male type of *compsias* (Meyrick); Kilauea, Hawaii; expanse, 35 mm.

this genus, but, as noted elsewhere in this text, there are references to many other Hawaiian Lepidoptera in the Seitz monograph.

Meyrick, in *Fauna Hawaïensis*, lumped all of the species of this genus together with *Pseudaletia* in *Leucania*, and the species have been placed in *Aletia*, *Eriopygodes* and *Hyssia* by various authors. When Warren described *Haliophyle*, he considered it to be related to the New Zealand *Alysina* Cockerell, 1913 (not *Alysia* Guenée, 1868, not *Alysia* Latreille 1804; misspelled *Halysia* by Warren in the German edition of Seitz, but corrected in the English edition), but I have not checked his conclusion, and I doubt it.

Hampson sorted out a number of what he considered aberrations of *euclidias* and listed them as "ab. 1," "ab. 2," "ab. 3" and "ab. 4." He placed little tags

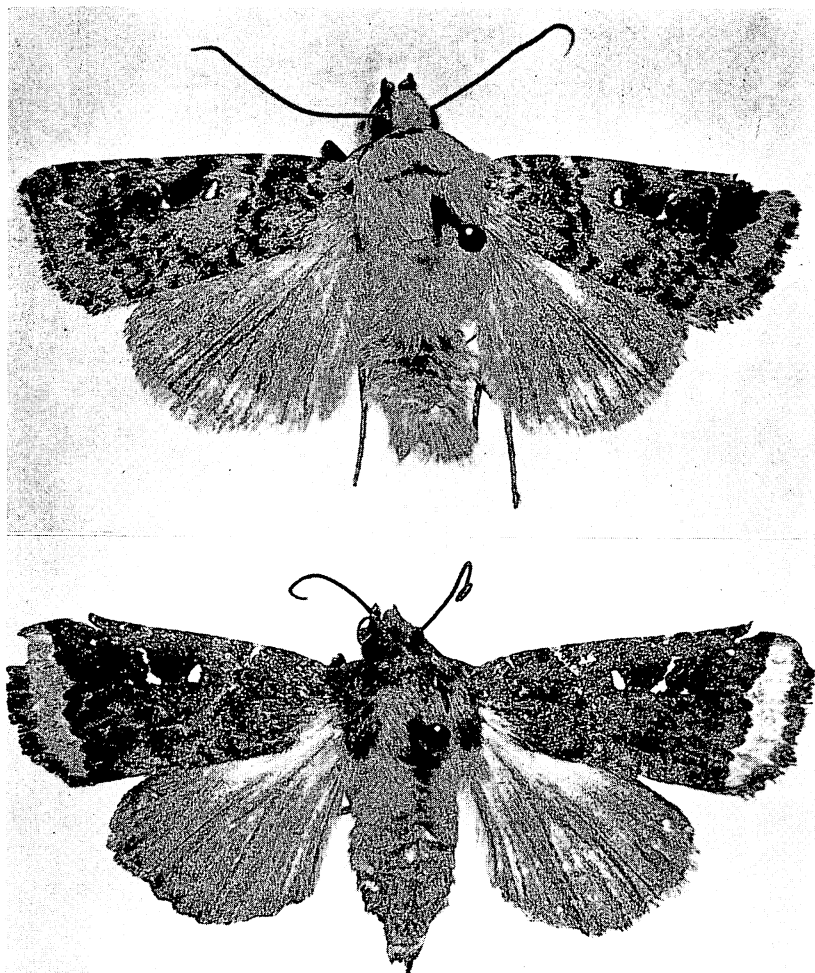


Figure 252—*Haliophyle compsias* (Meyrick). Above: A male from Olaa, 29 Miles, Hawaii, 3,800 feet; expanse, 37 mm. Below: A female color form; no data; expanse, 38 mm.

alongside a typical example of each of these "forms" in the drawers at the British Museum, and I have labeled these examples as lectotypes. Warren named three of Hampson's four "abs.," but he made no mention of the fact that Hampson had previously sorted these forms out and numbered them. Strand (1916:30) named Hampson's "ab. 2," which Warren had failed to name, as *depupillata*.

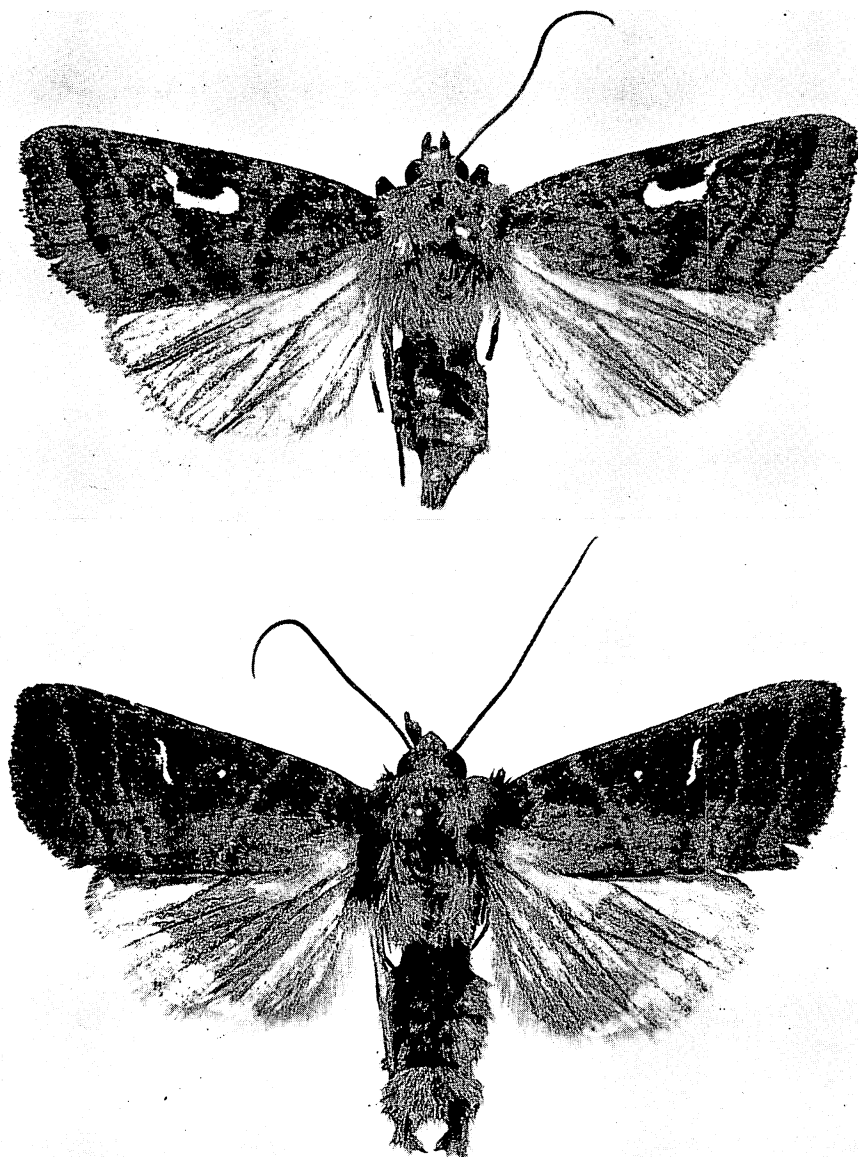


Figure 253—Above: *Haliophyle connexa* (Warren), lectotype female; Olaa, Hawaii, 2,000 feet; expanse, 36 mm. Below: *euclidias* (Meyrick), male type; Waimea Mts., Kauai, 4,000 feet; expanse, 36 mm.

Although Strand never saw the Hampson material, he went through Hampson's papers and gave names to Hampson's "abs."

This genus is an extraordinarily difficult complex of forms which appear to be in the process of active evolution, and much confusion has arisen concerning them. There are more species involved than the names indicate, and the group should be carefully revised. In *Fauna Hawaiiensis*, Meyrick gave colored illustrations of

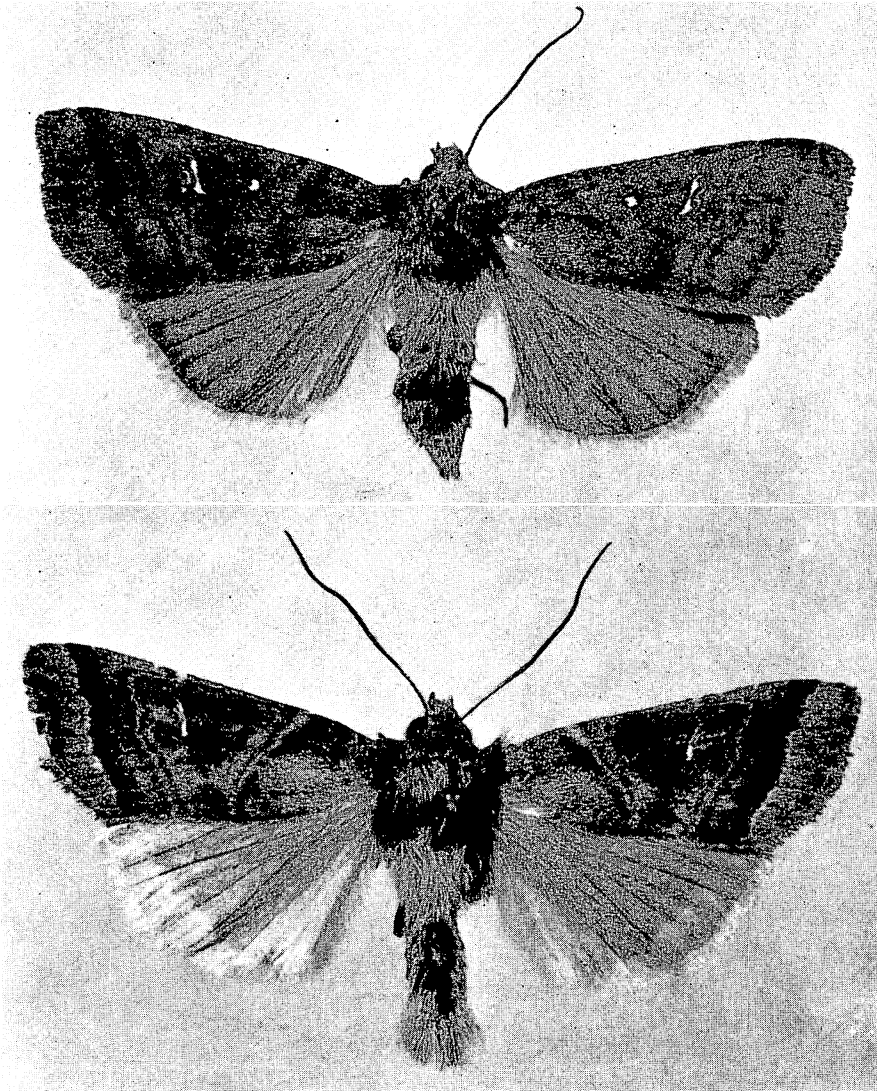


Figure 254—Above: *Haliophyle flavistigma* (Warren), female, quite similar to the lectotype; Haleakala, Maui, 5,000 feet; expanse, 38 mm. Below: Lectotype of *depupillata* (Strand), a synonym; Haleakala, Maui, 5,000 feet; expanse, 36 mm.



what he considered to be nine variations of *eulidias*, but Meyrick was completely confused by the group, and several species were involved. I have restricted the species as close as possible in accord with the holotypes, and the result is that names have been found only for species occurring on Kauai, Maui and Hawaii. There is an *eulidias*-like species on Oahu which is smaller than *flavistigma* or *eulidias* and is undescribed, and other species occur on Oahu. There are several

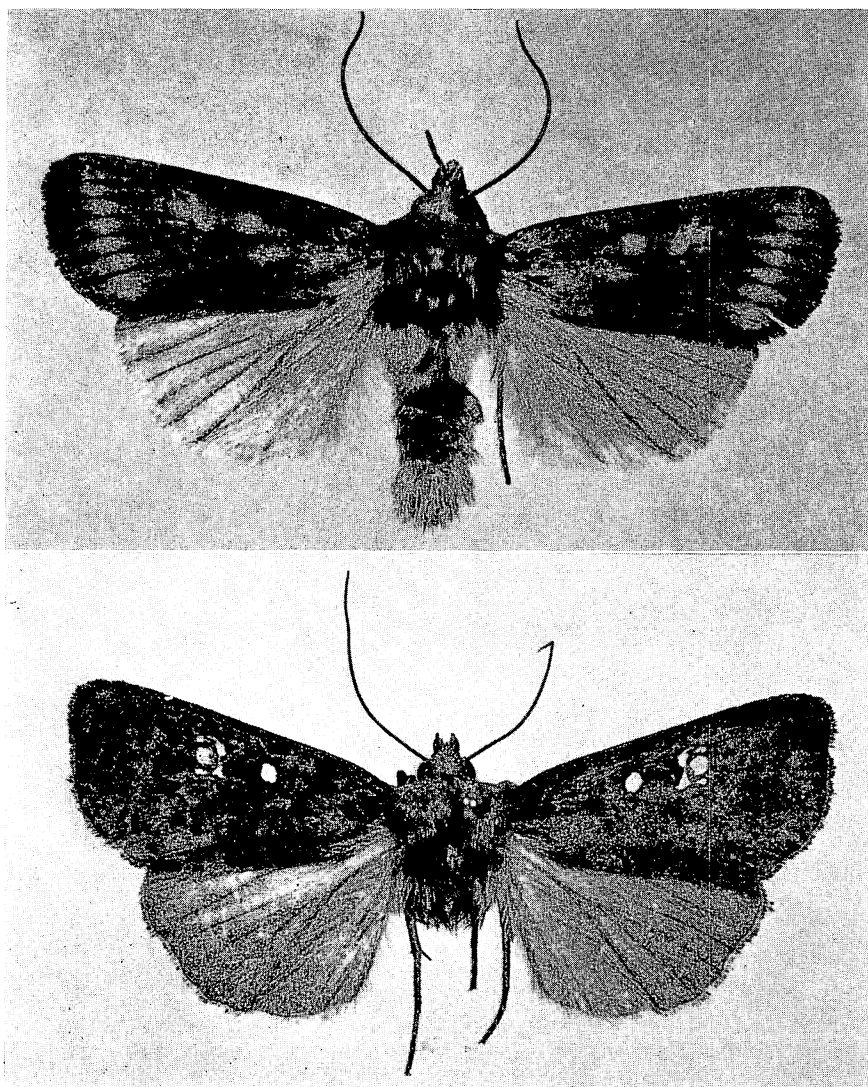


Figure 255—Above: *Haliophyle ignita* (Warren); Olaa, Hawaii; expanse, 34 mm.; the photograph conveys no impression of the beautiful bright red color of this species. Below: The female type of *niphadopa* (Meyrick); Olaa, Hawaii, 2,000 feet; expanse, 35 mm.



new forms on Hawaii. Some specimens have been collected on Molokai, but I have not examined them; they are probably new.

The group of red species—*euclidias*, *ignita*, *flavistigma*, *connexa* and several undescribed forms—constitutes a most difficult complex. Perhaps they all could be called subspecies; yet the genitalia of *euclidias* are so strikingly different that, judged upon these organs the species appears widely removed from the others. The “aberrations” sorted out under numbers 1 to 4 by Hampson—and later named by Warren and Strand—on the basis of the color of the orbicular and reniform spots are not well founded on these color characters, because the colors and shapes of the spots are variable. For example, in the British Museum series of *depupillata*, which is supposed to have “fore wing without white centre to orbicular,” the orbicular is black, white centered, mostly white, mostly yellow or yellow centered. The reniform is similarly variable. The form with the spots yellow was named *flavistigma* by Warren, but there is no reason to retain the Strand and Warren names for this variable form. These variations are duplicated in the series of *euclidias* before me. The only specimen in this *euclidias* complex which has the reniform and orbicular spots fused to form a white band is the female type of *connexa*. Another female has the reniform spot expanded backward, but the two spots are widely separated. The example I take to be the male of this (from Olaa, as is the female type of *connexa*) has the fore wing pattern nearly identical to the type of *depupillata*. One female which has been included with *compsias*, but which may not be that species, has the reniform and orbicular spots fused rather similarly to the type of *connexa*. A larger series of examples may show that this is another quite common variation of pattern. It is astonishing and confusing to find such differences in genitalia, yet to be unable to find any

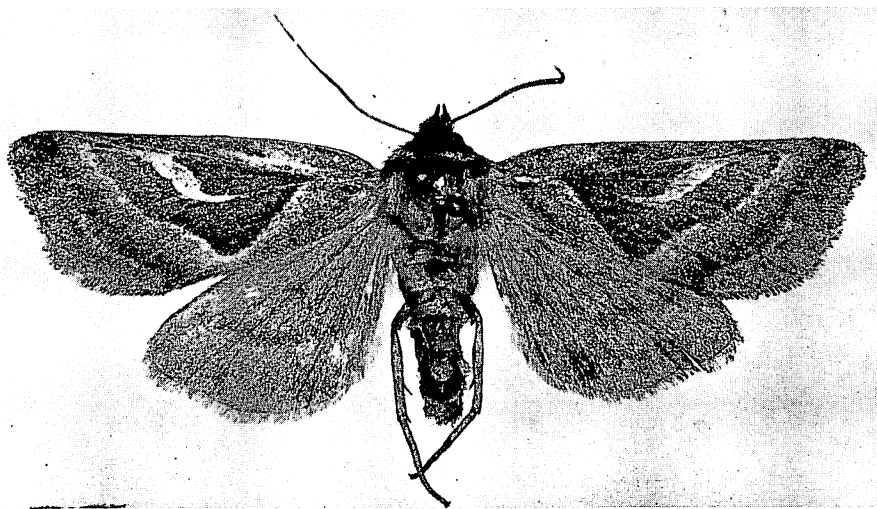


Figure 256—*Haliophyle ferruginea* (Swezey), the unique female type of this unusual species; Kula Pipe Line Trail, Maui; expanse, 48 mm.

stable external characters for separating these forms. The male genitalia of *euclidias* and *flavistigma* are extraordinarily distinct—yet some examples of these species appear identical in color and markings. This makes for much confusion. I leave the genus in an unsatisfactory state, and I must admit I can do no more until further studies are made in the field as well as in the laboratory.

Dr. Swezey has reported that the caterpillars, although of the cutworm type, remain on their hostplants during the day instead of hiding away in the soil or in debris. He has found them on several kind of ferns, including *Acrostichum* species and *Aspidium cyatheoides*, but evidently not on the abundant *Sadleria* and *Cibotium*.

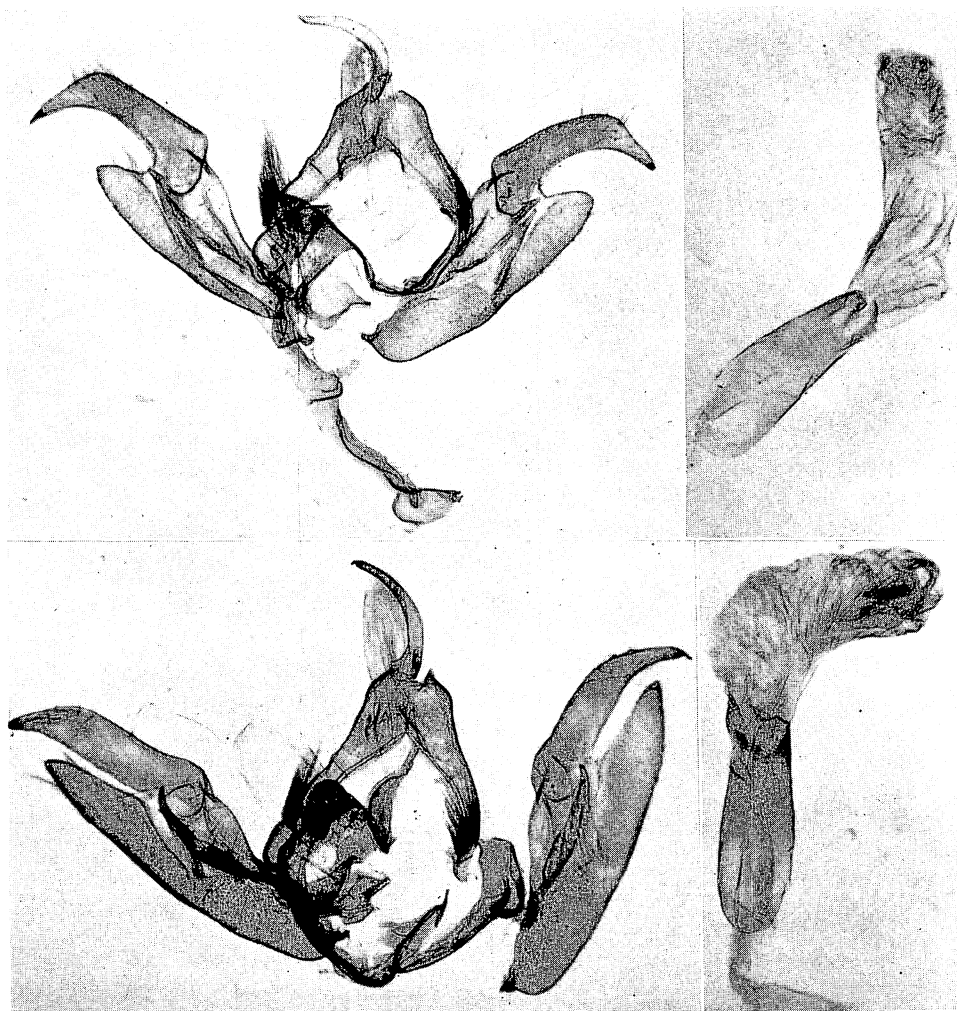


Figure 257—Male genitalia of *Haliophyle*. Above: The type of *anthracias* (Meyrick); Haleakala, Maui, 9,000 feet. Below: The type of *compsias* (Meyrick); Kilauea, Hawaii.

Perkins (1913:cxlvi), writing on this group, reported that:

All of these species are attracted to light and in some localities *L. euclidias* [possibly not this species] appears at all hours, but on the lower edge of the forest at Waialua on Oahu, we have observed on several occasions, that no more than a straggler or two were ever attracted until 11:30 P.M. or later, when scores would arrive in quick succession, till hundreds in all were present. No matter how favourable the earlier hours had been for the capture of other moths, *L. euclidias* never put in an appearance in numbers until near midnight, and striking varieties were in small proportion to the more usual forms, certainly far less numerous than in some of the wetter districts. All the species of this group are true forest insects and most abundant in wet forests. During the daytime the moths hide amongst dead leaves and are sometimes very numerous in the masses of dead fronds that remain attached to tree-ferns.

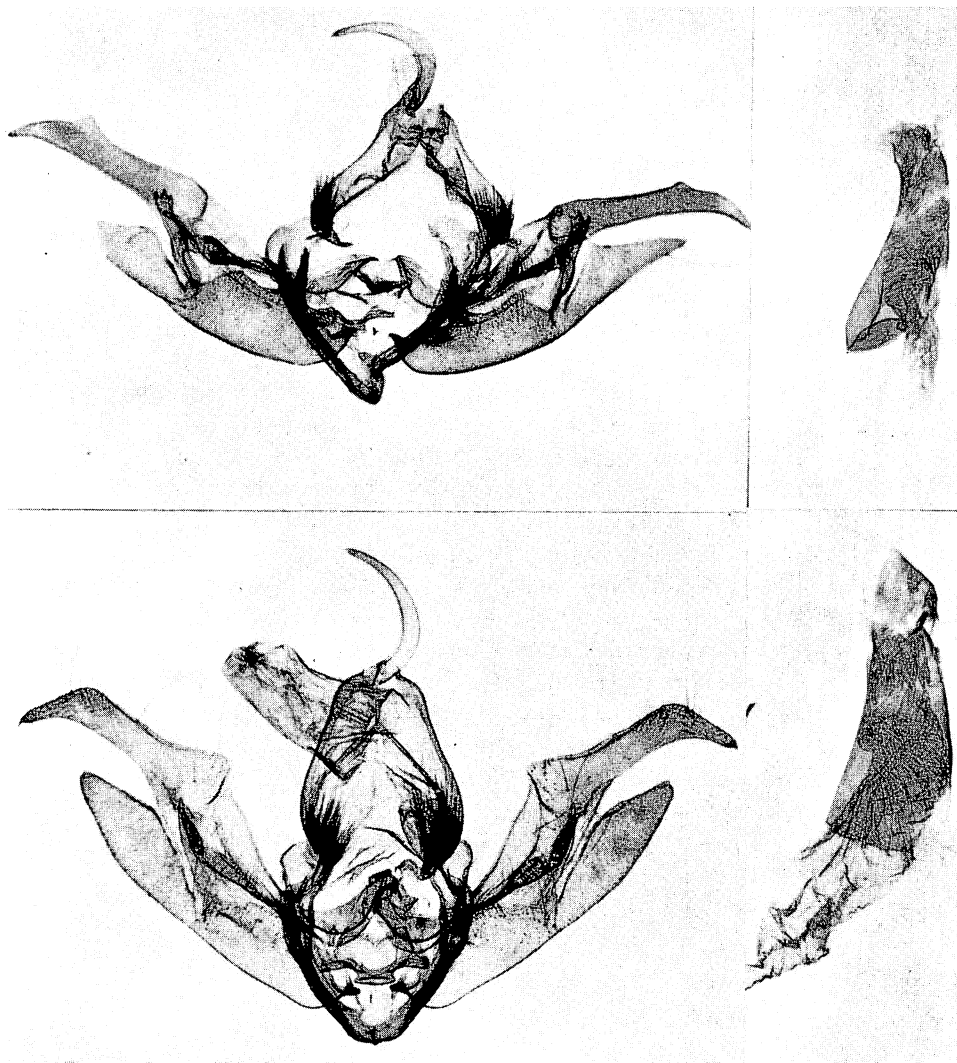


Figure 258—Male genitalia of *Haliophyle*. Above: *euclidias* (Meyrick); Waimea Mts., Kauai, 4,000 feet; (terminal spines on valves broken off and left valve damaged). Below: *flavistigma* (Warren), from the lectotype of *depupillata* (Strand), a synonym; Haleakala, Maui, 5,000 feet.

KEY TO THE SPECIES OF HALIOPHYLE

- 1. Fore wing with the antemedial and postmedial lines unusually oblique and joining at the hind margin of the wing so as to make a continuous line; antemedial line acutely angled distad from cell to costa; color pattern very distinctive, as in figure 256; Kula, Maui .....**ferruginea** (Swezey).  
Fore wing with the antemedial and postmedial lines always widely separated where they join the posterior margin of the wing, and pattern very different from *ferruginea* .....2
- 2(1). Fore wings largely dark brown to fuscous, not red .....3  
Fore wings largely reddish or chestnut colored .....5
- 3(2). Reniform spot dark, without white scales, orbicular spot pale but not white; a very dark colored species from Haleakala, Maui .....**anthracias** (Meyrick).  
Reniform spot white and yellow, orbicular white .....4
- 4(3). Head and thorax largely yellowish white; fore wing with a large amount of pale suffusion, subterminal line outlined externally with conspicuous white scaling, other transverse lines may also contain conspicuous white scaling; Hawaii .....**compsias** (Meyrick).  
Head and thorax brownish and fuscous; fore wing dark and lacking pale suffusion, the transverse lines not white-scaled; Hawaii .....**niphadopa** (Meyrick).
- 5(2). Fore wings and pronotum extensively and conspicuously fiery red; Hawaii .....**ignita** (Warren).  
Not fiery red, more brownish red or reddish brown .....6
- 6(5). Kauai species with male genitalia as in figure 258, the harpes broad, dentate at apices, and a long, accessory spine-like, dorsally projecting process arises from near base of each sacculus, as illustrated . .**euclidias** (Meyrick).  
Not so, harpes never so formed and never with a sub-basal process on sacculus .....7
- 7(6). Maui form (from Haleakala); male genitalia as in figure 258 .....**flavistigma** (Warren).  
Hawaii form (from Olaa-Kilauea region); as in figure 253 .....**connexa** (Warren).

**Haliophyle anthracias** (Meyrick) (figs. 251, 257).

*Leucania anthracias* Meyrick, 1899:139, pl. 4, fig. 1.

*Hyssia anthracias* (Meyrick) Hampson, 1905:284, pl. LXXXV, fig. 27.

*Haliophyle anthracias* (Meyrick) Warren, 1912:76, pl. 10b.

Endemic. Maui (type locality: Haleakala, 9,000 feet).

Hostplant: Unknown.

The specimen from Olaa, Hawaii, cited by Meyrick in his original description, belongs to a new species.



Figure 259—Male genitalia of *Haliophyle*. Above: *ignita* (Warren), lectotype; Olaa, Hawaii. Below: *flavistigma* (Warren); Haleakala, Maui, 5,000 feet.

**Haliophyle compsius** (Meyrick), type of *Haliophyle* (figs. 250, 251, 252, 257, 261).

*Leucania compsius* Meyrick, 1899:139, pl. 4, fig. 2.

*Hyssia compsius* (Meyrick) Hampson, 1905:283, fig. 60.

*Haliophyle compsius* (Meyrick) Warren, 1912:76, pl. 10b.

Endemic. Hawaii (type locality: Kilauea).

Hostplant: Unknown.

**Haliophyle connexa** (Warren), **new status** (figs. 253, 261).

*Eriopygodes euclidias* "ab. 1" Hampson, 1905:356.

*Haliophyle euclidias* aberration *connexa* Warren, 1912:76.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: Unknown.

**Haliophyle euclidias** (Meyrick) (figs. 253, 258, 262).

*Leucania euclidias* Meyrick, 1899:140, pl. 4, fig. 1, in part.

*Eriopygodes euclidias* (Meyrick) Hampson, 1905:355, pl. LXXXVIII, fig. 14, in part.

*Haliophyle euclidias* (Meyrick) Warren, 1912:76.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet).

Host plant: ferns.

This species name has been a catch-all for several species, and much confusion exists regarding its identity in collections and literature. In so far as I am able to determine, the species is confined to Kauai. The male genitalia are conspicu-

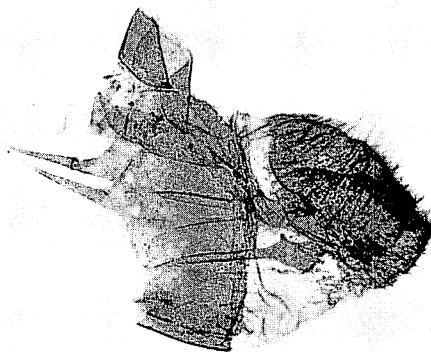


Figure 260—Female genitalia of *Haliophyle ferruginea* (Swezey); Kula Pipe Line Trail, Maui. Bursa decomposed.

ously distinct from all of the other species thus far studied in the genus. The harpes or claspers (not to be confused with the valves) are dentate at the apices, and a long spine-like process arises from near the base of each sacculus. None of the other species has dentate harpes, and none shows any tendency toward the development of the accessory process on the sacculus.

The records in literature are so confused that most of them must be ignored.

**Haliophyle ferruginea** (Swezey), **new combination** (figs. 256, 260).

*Aletia ferruginea* Swezey, 1932:197.

Endemic. Maui (type locality: Kula Pipe Line Trail).

Hostplant: Unknown.

This species departs widely from all of the other known species of the genus in its color and color pattern and is the easiest of all of the species to recognize. Unfortunately, only the holotype is known. Swezey stated that it was a male, but I have dissected it and found it to be a female. One wonders what the male genitalia will reveal in view of its very distinct external appearance.

**Haliophyle flavistigma** (Warren), **new status** (figs. 254, 258, 259, 262).

*Eriopygodes euclidias* "ab. 3" Hampson, 1905:356.

*Haliophyle euclidias* aberration *flavistigma* Warren, 1912:76.

*Eriopygodes euclidias* "ab. 2" Hampson, 1905:356.

*Eriopygodes euclidias* aberration *depupillata* Strand, 1916:30. **New synonym.**

Endemic. Maui (type locality: Haleakala, 5,000 feet).

Hostplant: Unknown.

The lectotypes of both Warren's name and Strand's were taken at the same time and place, and, as noted in the introductory remarks to this genus, they represent the same species and Strand's name must fall.

**Haliophyle ignita** Warren), **new status** (figs. 255, 259).

*Eriopygodes euclidias* "ab. 4" Hampson, 1905:356.

*Haliophyle euclidias* aberration *ignita* Warren, 1912:76.

Endemic. Hawaii (type locality: Olaa).

Hostplant: Unknown.

I have collected, or examined, specimens from Oahu which appear much like this Hawaii species, but they have not been described. I recall collecting a fine example on Mt. Kaala over 22 years ago.

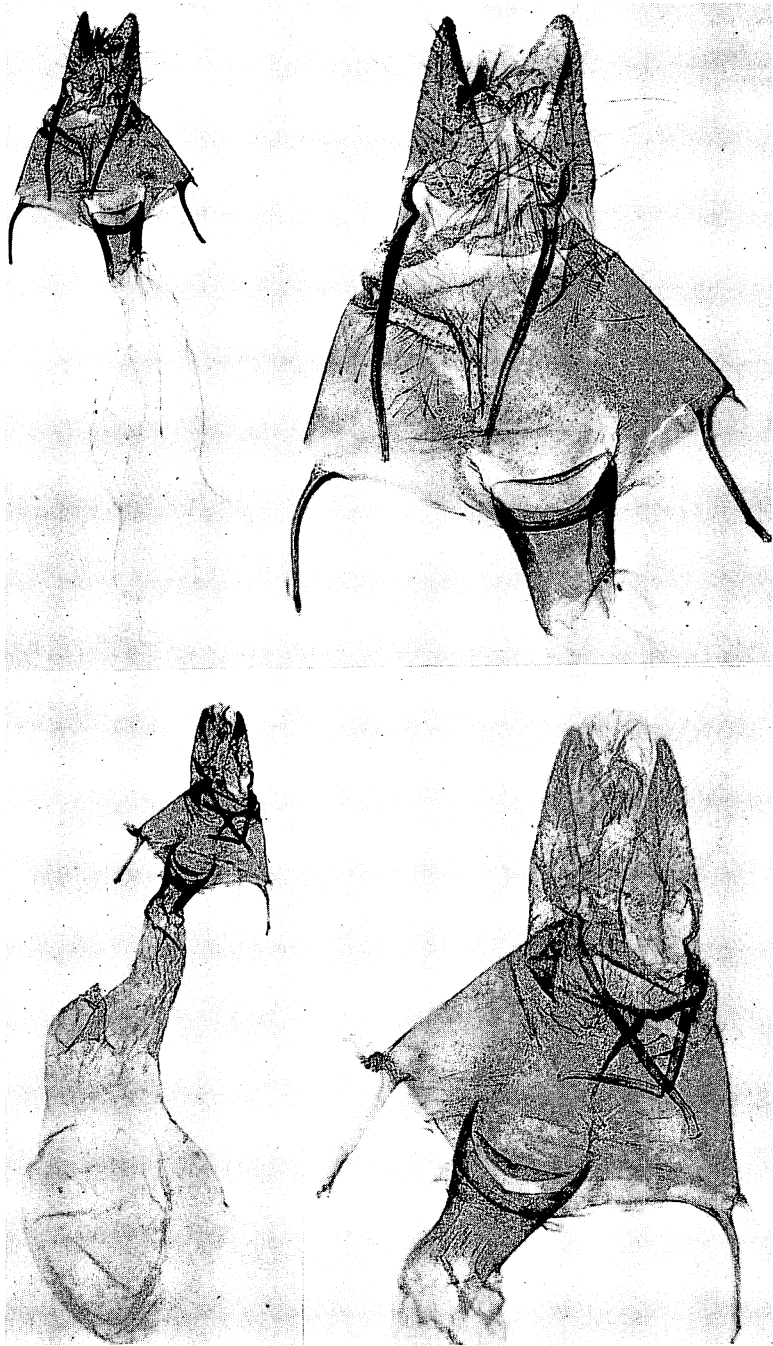


Figure 261—Female genitalia of *Haliophyle*. Above: *compsias* (Meyrick); Kilauea, Hawaii. Below: *connexa* (Warren), lectotype; Olaa, Hawaii, 2,000 feet.



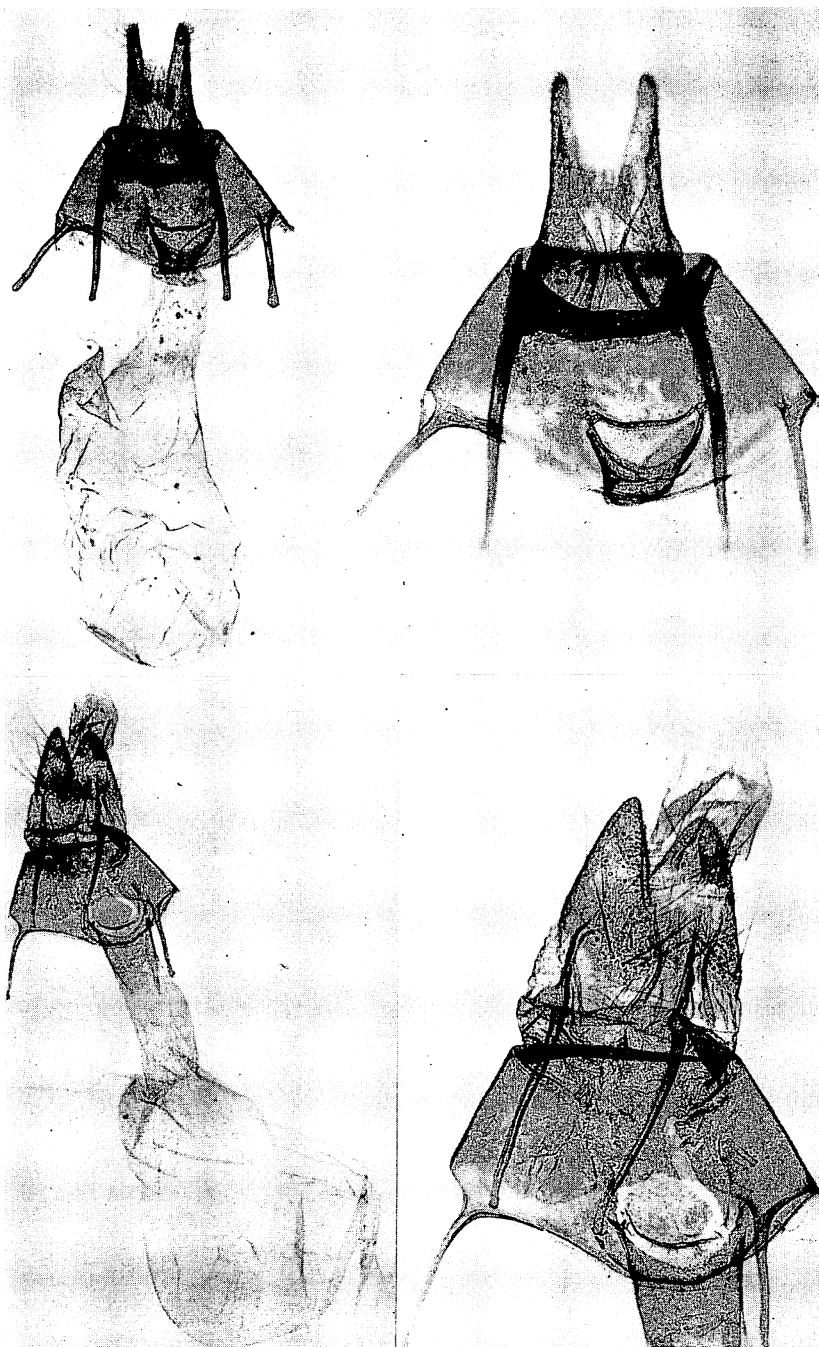


Figure 262—Female genitalia of *Haliophyle*. Above: *euclidias* (Meyrick); Oloa, Hawaii. Below: *flavistigma* (Warren), lectotype; Haleakala, Maui, 5,000 feet.

**Haliophyle niphadopa** (Meyrick) (figs. 255, 263).

*Leucania niphadopa* Meyrick, 1899:140.

*Hyssia niphadopa* (Meyrick) Hampson, 1905:283, pl. 88, fig. 26.

*Haliophyle niphadopa* (Meyrick) Warren, 1912:76, pl. 10a.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: Unknown.

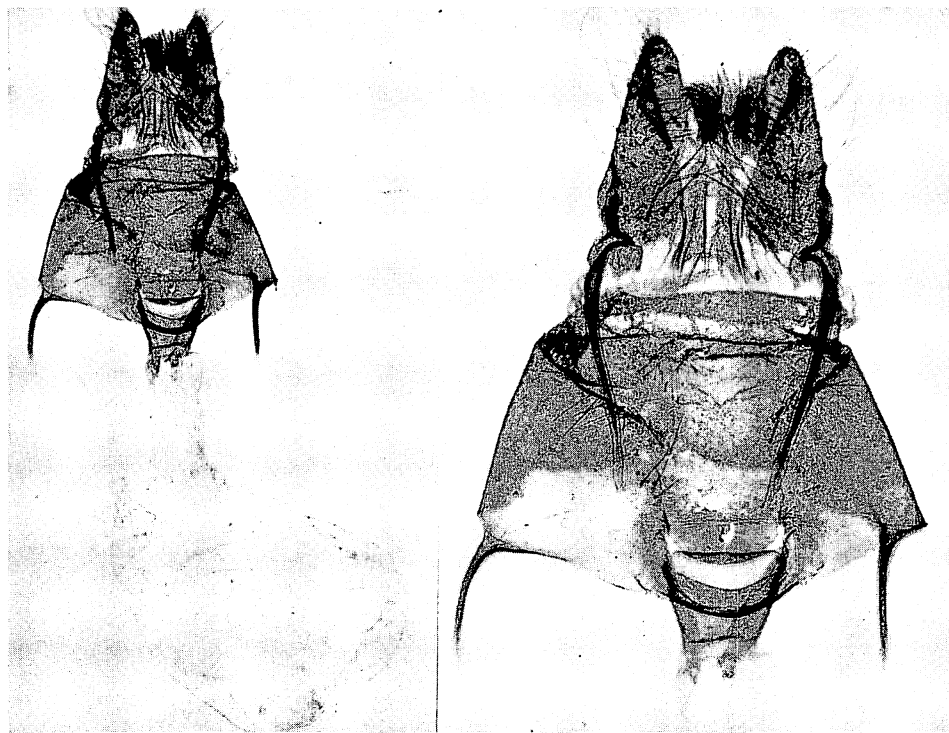


Figure 263—Female genitalia of the type of *Haliophyle niphadopa* (Meyrick); Olaa, Hawaii.

Subfamily APAMEINAE

*Apamidae* Guenée, 1852:119.

*Acronyctidae* Heinemann, 1859:297.

*Apamiidae* Cotes and Swinhoe, 1887:315.

*Apameinae* Kirby, 1897:22.

*Caradrininae* Kirby, 1897:35.

*Zenobianae* Hampson, 1918:383.

Genus **ACRAPEX** Hampson, 1894

**Acrapex exanimis** (Meyrick) (figs. 264, 265, 266).

*Caradrina exanimis* Meyrick, 1899:153.

*Acrapex exanimis* (Meyrick) Hampson, 1910:314. Meyrick, 1928:92, redescription.

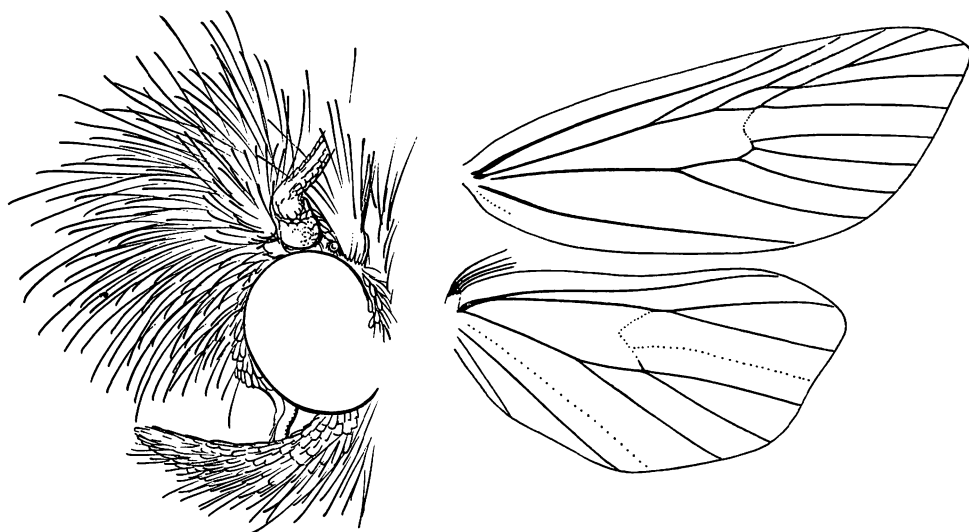


Figure 264—Head (left) and wing venation (right) of *Acrapex exanimis* (Meyrick).

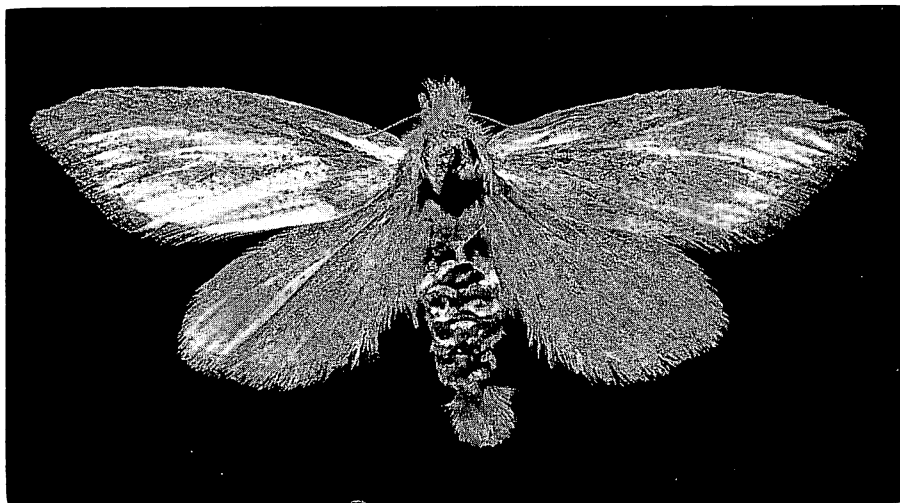


Figure 265—*Acrapex exanimis* (Meyrick); Honolulu; expanse, 25 mm.

Oahu, Hawaii (type locality: Kona, 1,500 feet).

Immigrant. Although this species has not been recorded outside of Hawaii, I believe that it is an immigrant, and it may be Australian.

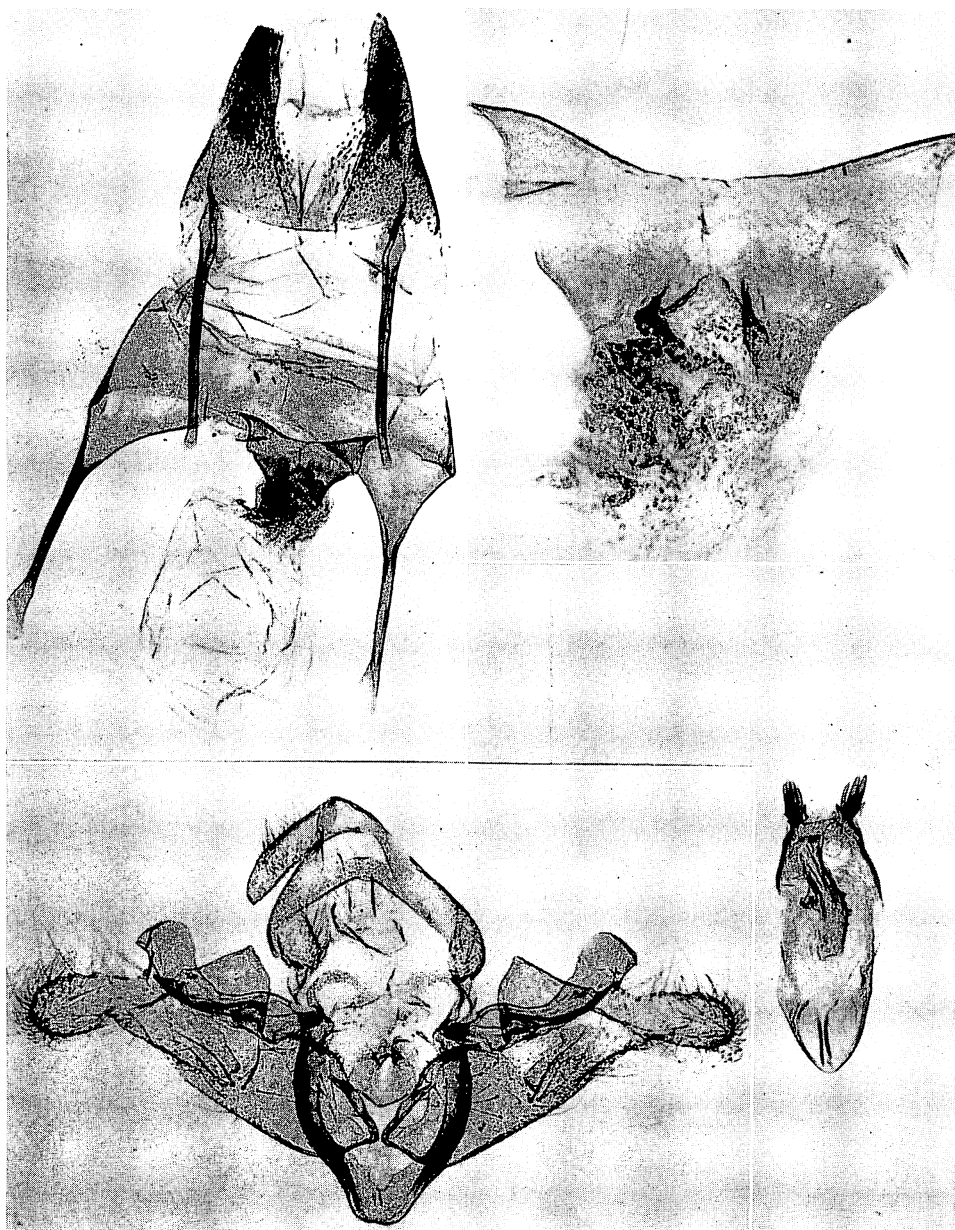


Figure 266—Genitalia of *Acrapex exanimis* (Meyrick). Above: The female type; Kona, Hawaii. Below: Male; no data.

Hostplants: *Panicum kaalense*, *Panicum torridum*.

Predator: An undetermined mite.

Hampson said that this species was the same as *exsanguis* Lower, from Australia, but he was in error. I have compared the genitalia of the female holotype of *exanimis* with *exsanguis*, and they are different. Also, *exanimis* is definitely more hairy. It is closely similar to *exsanguis*, however.

The caterpillars are grass stem borers. Egg clusters of 17 to 25 eggs were found by Swezey (1928:179–181) behind grass leafsheaths, and he made the following notes on the caterpillars:

Larvae obtained in the field and about full-grown were whitish without markings, spiracles black, head uniform yellowish or stramineous, eyes black, thoracic shield concolorous with head, but paler. The larvae apparently migrate from one stem to another, for in many bored stems with "dead hearts" not enough eating had been done to suffice for the growth of a larva.

Pupation takes place in a slight cocoon where the larva finally finished eating. From larvae brought in, it is apparent that there is a period of a week or more after the larva finishes eating before pupation takes place. About two weeks were occupied in the pupal stage. The pupa is about 11 mm. long, rather slender, quite uniformly pale brown; the wing cases extend to the apex of the third abdominal segment; cremaster slightly blackened, blunt, somewhat roughened, without spines or hooks.

Perkins captured a single female in 1892, and the species remained unknown to local workers until it was rediscovered in February, 1927, in dry areas of southeast Oahu by Dr. Swezey.

The female has four setae in the frenulum.

### Genus **ELAPHRIA** Huebner

*Elaphria* Huebner, 1818:16, 1821:230; type *Elaphria grata* 1818:16.

*Monodes* Guenée, 1852:241.

Barnes and Benjamin, 1929:181, notes.

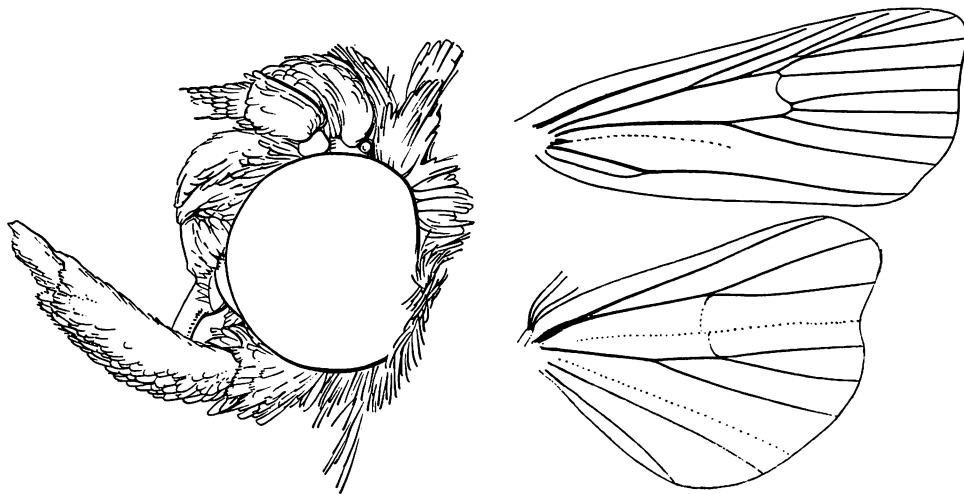


Figure 267—Head (left) and wing venation (right) of *Elaphria nucicolora* (Guenée).

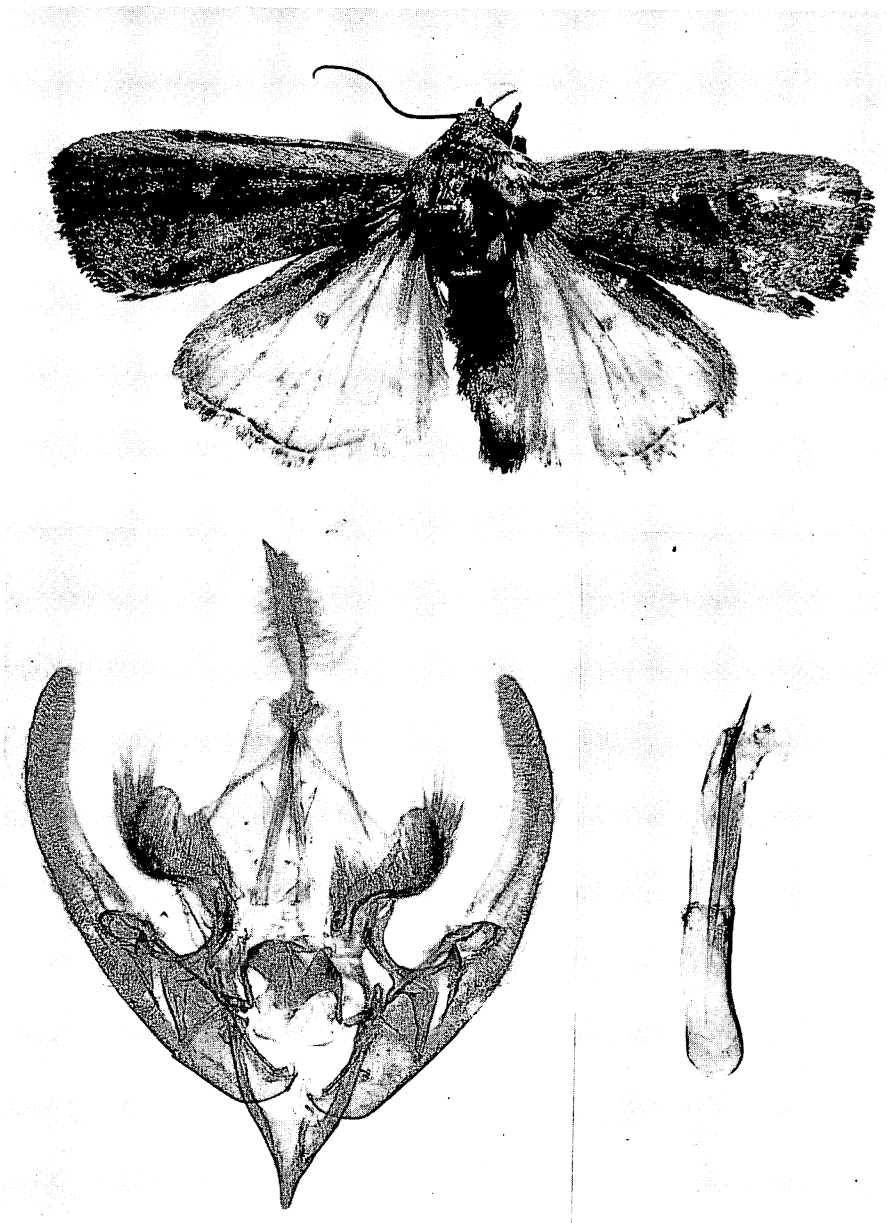


Figure 268—*Elaphria nucicolora* (Guenée). Above: An example compared with the type; Wahiawa, Oahu; expanse, 27 mm.; (this photographic print is too dark). Below: Male genitalia from an example from Florida, U. S. A.

***Elaphria nucicolora* (Guenée) (figs. 267, 268, 269).**

*Monodes Nucicolora* Guenée, 1852:241. Hampson, 1909:466, fig. 136.

*Laphygma unisignata* Walker, 1856:189.

*Caradrina clara* Harvey, 1878:57.

Oahu, Maui, Hawaii.

Immigrant; described from Florida, U.S.A. Widely distributed from South America to southern United States. First reported from Hawaii by Swezey (1947: 99) from specimens taken as early as June, 1945, in a light trap at Pearl Harbor.

Hostplants: Watermelon; fed experimentally by Swezey on *Emilia flammea*, *Euphorbia hirta*, *Portulaca oleracea* and *Synedrella nodiflora*; also reported to attack sugarcane in Florida (see J. W. Ingram, H. A. Jaynes and R. N. Lobdell, *Proc. Int. Soc. Sugar Cane Tech.* 6:89-98, 1939).

Parasite: *Meteorus laphygmae* Viereck?

According to Swezey (*Proc. Hawaiian Ent. Soc.* 14(2):217, 1951), the caterpillar is rather similar to that of *Elydna nonagrica* (Walker) and is "nearly uniform dark fuscous, variegated with black. There is a fine, pale, middorsal line; the dorsal setae are minute and situated in minute, pale, black-ringed spots. There is a distinct, small, yellow lateral spot on either side of the first abdominal segment. The head is dark and distinctly narrower than the prothorax. The spiracles are oval, black and pale-ringed."

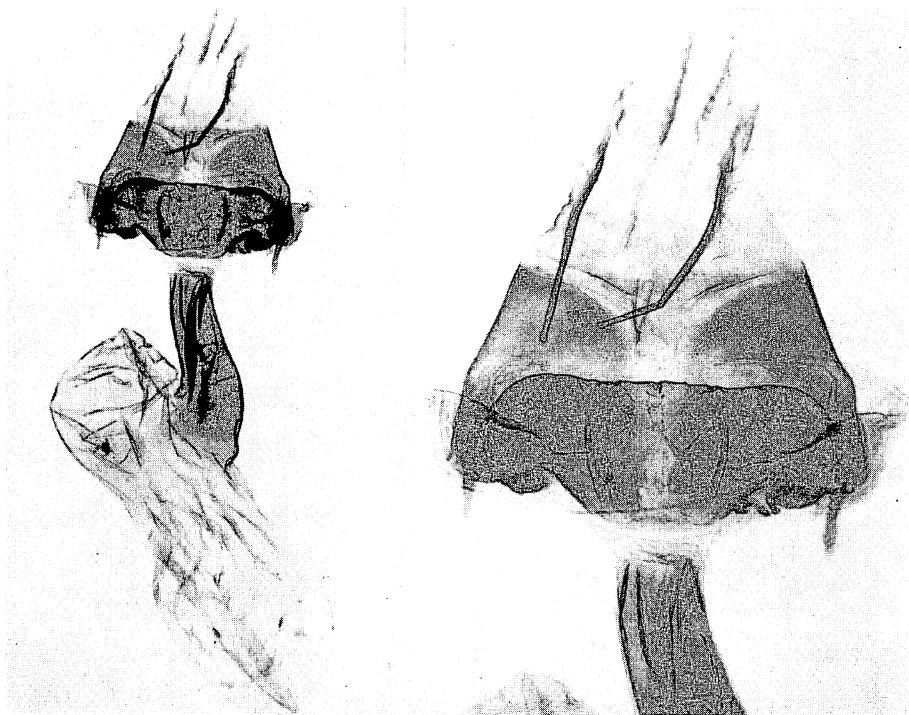


Figure 269—Female genitalia of *Elaphria nucicolora* (Guenée), from Florida, U. S. A.

Genus **ELYDNA** Walker, 1858:1712

**Elydna nonagrica** (Walker) (figs. 270, 271, 272).

*Curgia nonagrica* Walker, 1864:166, type of *Curgia*.

*Caradrina reclusa*, of Hampson, 1894:264.

*Elydna reclusa*, of Hampson, 1910:164, fig. 55.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant. Widespread from India through Malaysia to southeastern Polynesia. First recorded from Hawaii by Swezey (1908:3), but first found in Honolulu by Perkins in 1902 or 1903 (Perkins, 1913:cxlv and cxlviii). It is believed to have been accidentally introduced from Fiji. It was common by 1906.

Hostplants: *Commelina*, *Eugenia malaccensis*, *Portulaca*. Swezey found that they would also eat the leaves of sweetpotato, grass and bean in the laboratory, but they did not take readily to sugarcane.

A moth captured by Swezey laid 216 eggs, which were scattered about on the leaf surfaces and not laid in clusters, and he gave the following detailed account of the immature stages of the moth (1908:4-5), which I quote at length because it is one of the few most complete accounts of the early stages of any moth in Hawaii:

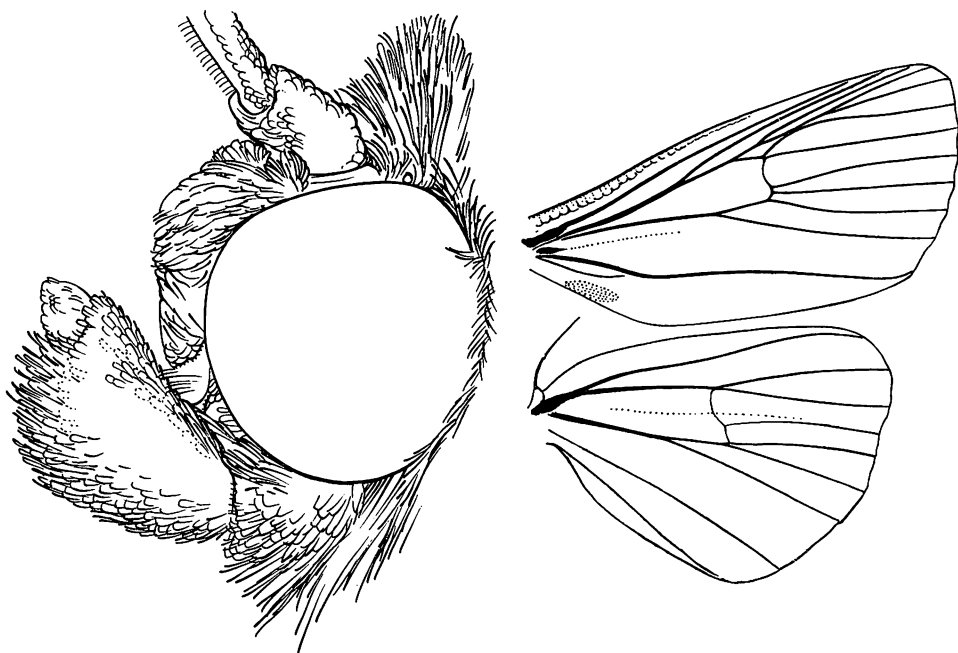


Figure 270—Head (left) and wing venation (right) of *Elydna nonagrica* (Walker).



The egg is hemispherical, having the flattened surface next to the leaf; ribbed meridionally with about 30 ribs, 10 of which reach the upper pole; slight cross ridges between the ribs; at the upper pole an irregular patch of reddish color, an irregular ring of the same color at about  $\frac{1}{3}$  the distance from pole to base of egg, remainder of egg pale green, when first laid, entirely pale green, the reddish markings appearing soon after. Eggs hatched in 5 days.

Larva: 1st stage—about 2 mm. long when first hatched; dull whitish, head black; cervical shield and tubercles nearly black. The hairs in tubercles quite prominent, dark. They crawl by a looping motion, using of the prolegs, only the anal and those on segment 10, the other prolegs are rudimentary. They eat off the surface of the leaves, leaving one epidermis.

2nd stage—about 4 mm. long, pale mottled reddish green, with a dorsal and on each side a subdorsal stripe, paler, head very pale luteous, eyes black; tubercles small, with a tiny blackish

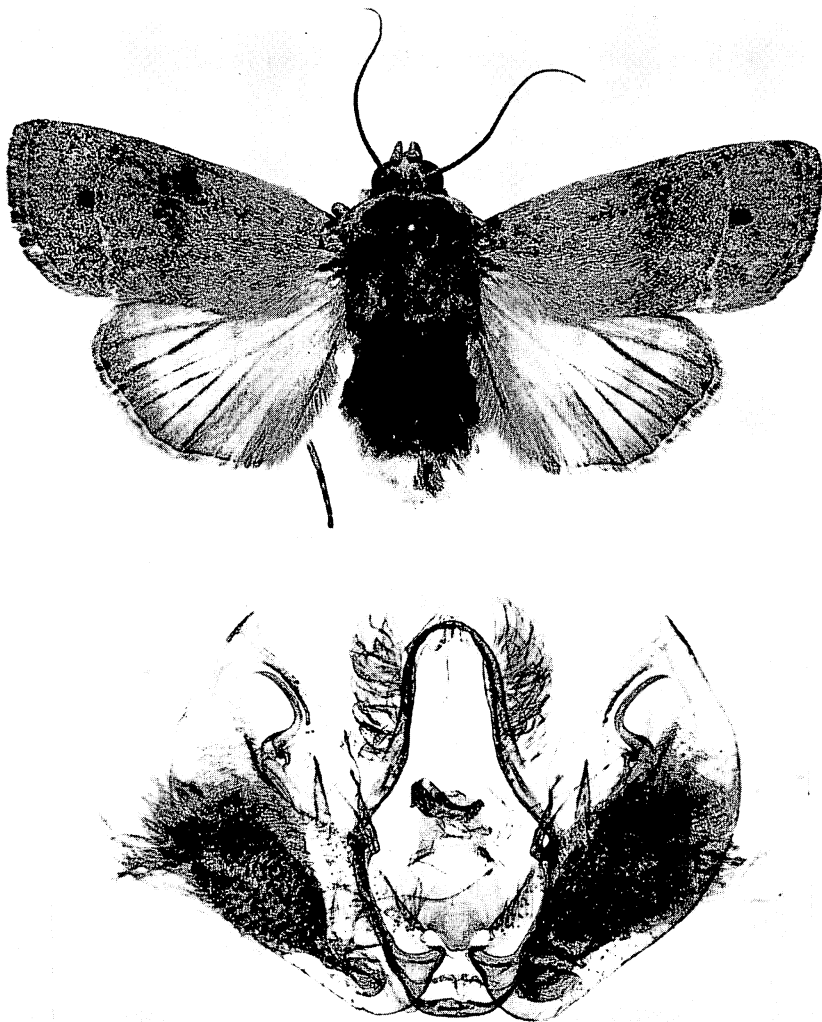


Figure 271—*Elydna nonagrica* (Walker); Opauala, Oahu; expanse, 35 mm. The color pattern is variable; the black spots on the fore wings are often absent. Male genitalia of a Honolulu example, at bottom.

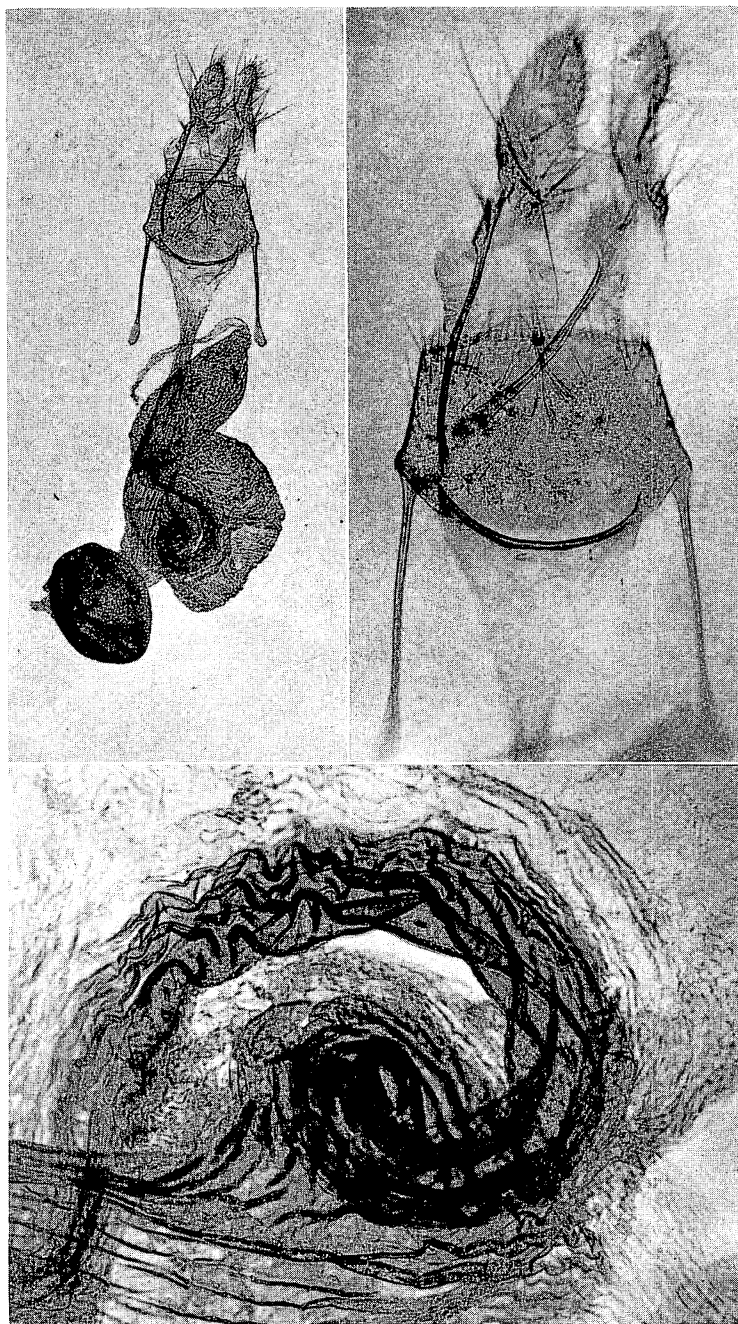


Figure 272—Female genitalia of *Elydna nonagrica* (Walker); Mt. Tantalus, Oahu.

dot at base of hairs; hairs pale, shorter than in first stage. They now use abdominal prolegs of segments 9 and 10 (others rudimentary) and still crawl by a looping motion. They now eat holes through the tender leaves; but in older leaves, leave one epidermis.

3rd stage—about 6–8 mm. long; very much mottled with greenish, blackish and some times a faint reddish tinge; a dorsal whitish line on each side, darker along ventral side; segment 12 slightly swollen, two whitish spots on dorsal side; segment 6 also has two white spots on dorsal side each in a subdorsal line; tubercles white; hairs very short; head slightly fuscous except the upper and posterior parts which are pale brown where usually withdrawn into segment 2, eyes black; cervical shield darker than rest of body with dorsal white line less prominent than on other segments, the subdorsal lines more prominent. All prolegs now fully developed.

4th stage—15–17 mm.; much more mottled and variegated than preceding stage with black, browns, olivaceous, yellowish and whitish, the darker colors predominating; two more or less conspicuous sub-dorsal rows of black spots on segments 7–12, a broad paler region on dorsum between these, in the middle of which is a series of obscure lozenge-shaped darker spots; head mostly black except the periphery (portion covered when retracted) which is pale brown; two conspicuous whitish sub-dorsal spots on segment 6; posterior sub-dorsal parts of segment 12 and upper parts of segment 13 yellowish; spiracles black, a yellowish streak below them; tubercles not conspicuous, same color as place where situated, hairs short; 12th segment quite swollen.

5th and 6th stages—very similar to fourth stage, but usually darker, almost black. When full-grown 26–32 mm. long. When disturbed the caterpillars drop from the leaf where feeding and mostly lie straight and rigid, feigning death. When smaller they dropped and curled up when disturbed.

The five molts occur at intervals of 3–9 days usually about 4 days; and the caterpillars become full-grown in 30–40 days.

The pupa is formed in the soil, an inch or two below the surface. It is 13–15 mm. long; uniform medium brown, eyes black, wing-, leg- and antenna-cases extend to apex of 4th abdominal segment; articulations between segments 4–7 movable; a row of about 20 pits on dorsal part of basal margin of segments 5, 6, and 7, from the ends of these rows a band of punctures extends around the ventral side; apex of abdomen blunt and rounded, with two dark spines placed near together, their tips converging, slightly ventrally curved. Pupal period 12–14 days.

The full-grown caterpillar has abdominal prolegs on segments 3, 4, 5 and 6, and the "Head dark brown in front, paler on vertex and laterally; body dark with a velvety appearance; two dorso-lateral darker spots on abdominal segments 6 and 7; spiracles black." (Swezey, 1944:142.)

This species has appeared in our literature as *Caradrina reclusa* (Walker), because of widespread misidentification. It is a variable species. The heavy scaling on the fore wing of the male is noteworthy.

### Genus **SPODOPTERA** Guenée

*Spodoptera* Guenée, 1852:153; type *Hadena mauritia* Boisduval, cited by Hampson, 1909:256.

*Laphygma* Guenée, 1852:156; type *Noctua exigua* Huebner, cited by Hampson, 1909:265. **New synonym.**

There appear to be no stable characters of generic value between the types of *Spodoptera* and *Laphygma*, and the merging of the genera is recommended. Three immigrant, widespread, variable pest species represent this genus in Hawaii.

This genus is evidently allied to *Prodenia*. The widespread, well-known *Prodenia litura* (Fabricius), a pest of major importance, was recorded from Hawaii by Hampson (1909:247), who listed a female supposedly collected in Hawaii by

Perkins. This record is, however, in error. For colored illustrations of egg, larvae, pupa and adults of *Prodenia litura*, see Fletcher, 1914:377, pl. 19.

The spurs on the middle tibiae of the males of this group display excellent specific characters, but I have not seen attention called to them before. The females are more difficult to separate than the males, especially *exempta* and *exigua*, but once familiar with their differences, one can readily separate mixed series. There are also differences in degrees of color which are difficult to put accurately into words conveying clear meaning to the reader and can best be appreciated by comparing specimens.

These are truly "army-worms" marching over great areas of pasture land and devouring all the herbage on their march. Of late years these great armies have been much less frequently noticed, though formerly of annual occurrence at the season of growth of fresh grass. There is no doubt that this diminution of the ravages of the grass army-worms was due to the excessive multiplication of the imported Indian mynah bird (*Acridotheres tristis*), great flocks of which visited the pasture lands to feed on the caterpillars. Of late years it would appear that the mynah bird has become less numerous, owing to the failure of lantana berries, which formed its chief supply of food throughout the year, and it is said that, coincidently with this decrease, the army-worm has again occasionally become conspicuous in some pastures. Previous to the great multiplication of the mynah bird, this *Spodoptera* was a favourite and important food supply of the golden plover in the winter months. It is well known that, when feeding on hordes of caterpillars, these migrants from Alaska arrived in their finest condition, before leaving the islands for their distant breeding grounds. (Perkins, 1913: cxlviii.)

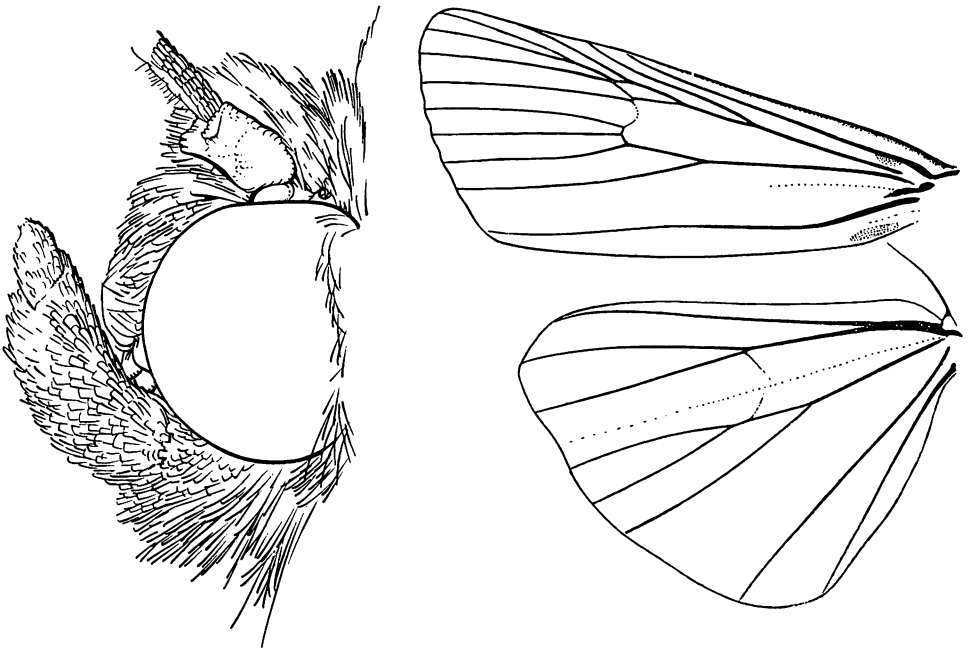


Figure 273—*Spodoptera*. Left: Head of *mauritia* (Boisduval). Right: Wing venation of *exigua* (Huebner).

KEY TO THE SPECIES OF *Spodoptera* IN HAWAII

1. Males (frenulum consisting of a single spine).....2  
 Females (frenulum compound).....4

*Males*

- 2(1). Fore tibia with an enormous mass of long hair and scales, part of which extends as far as apex of tarsus; outer spur on middle tibia only slightly shorter than inner spur, the specialized, non-squamose, densely setose area on inner spur confined to basal half (figure 274); fore wings usually appearing basically dark brown..  
 .....***mauritia acronyctoides*** (Guenée).

Fore tibia without such a mass of hair and scales, the hairs and scales present never extending farther than onto the first tarsal segment; outer spur on middle tibia much shorter than inner spur, the specialized setose area on inner spur extends beyond middle of spur; fore wings usually paler, usually basically more straw-colored, but variable.....3

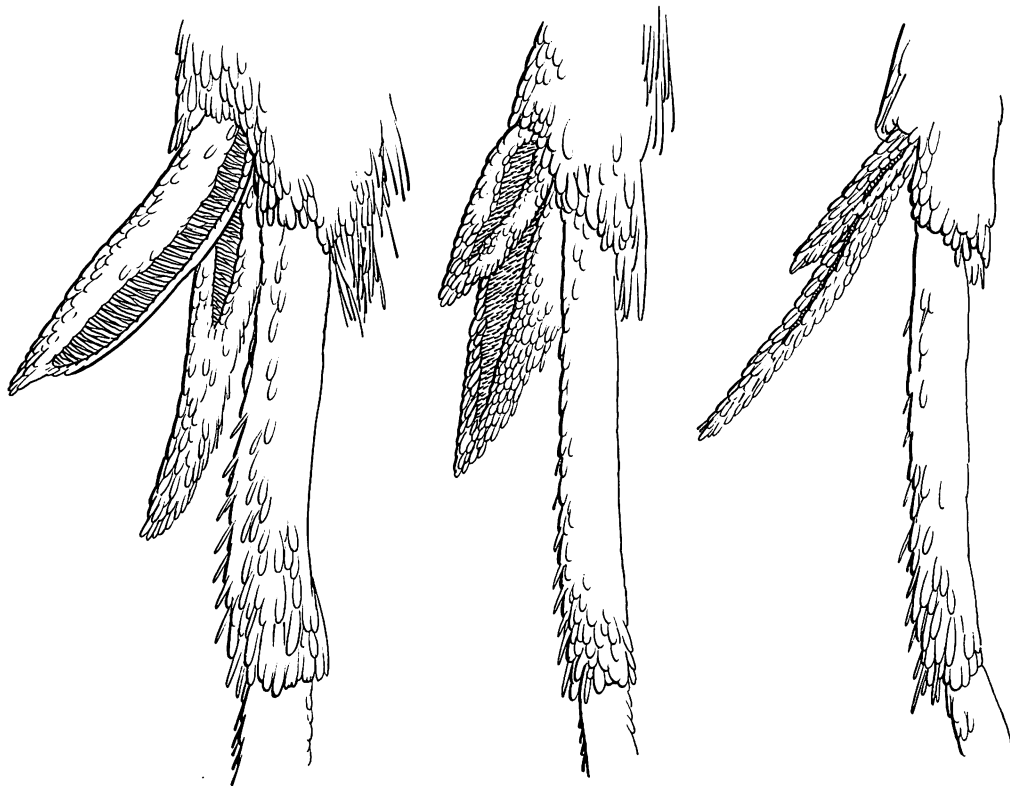


Figure 274—Apical tibial spurs of middle legs of male *Spodoptera* to illustrate specific differences. From left to right: *mauritia acronyctoides* (Guenée), *exempta* (Walker), *exigua* (Huebner).

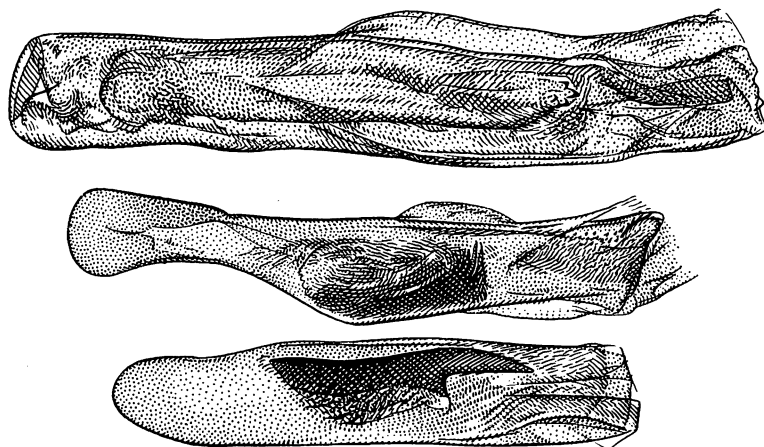


Figure 275—Aedeagi of *Spodoptera*. From top to bottom: *mauritia acronyctoides* (Guenée), *exempla* (Walker), and *exigua* (Huebner).

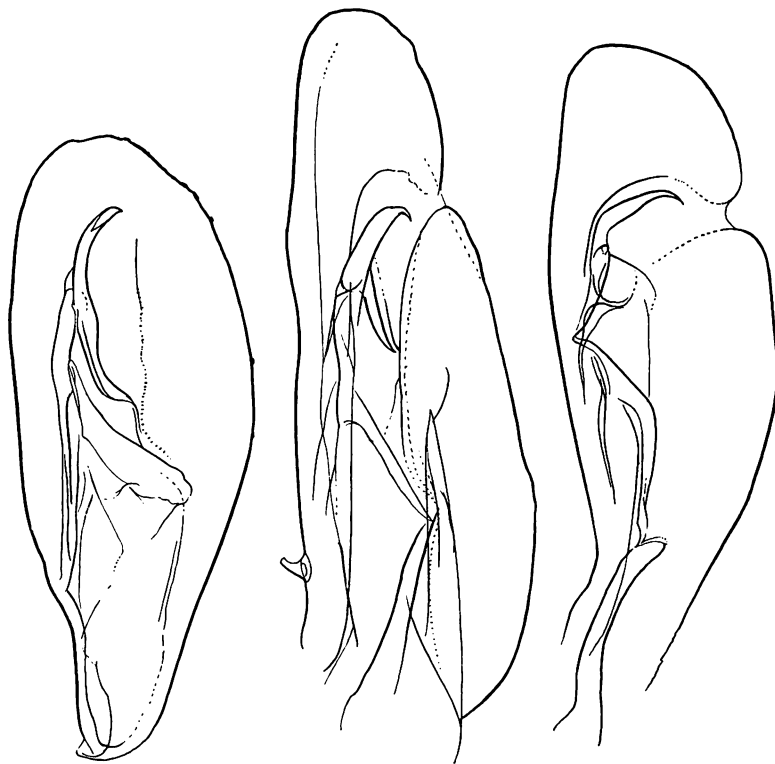


Figure 276—*Spodoptera*. Right male genital valves of *exigua* (Huebner), left; *mauritia acronyctoides* (Guenée), center; *exempla* (Walker), right.

- 3(2). Fore wings with a pale diagonal band running from near costa between orbicular and reniform spots toward inner apical angle of wing; reniform spot usually quite dark brown; orbicular spot usually elongate-ovate and oblique; both spurs on middle tibia very broad, lanceolate, the specialized setose areas broad and well developed (figure 274).....**exempta** (Walker).

Fore wings lacking the pale diagonal band as described above; reniform spot not very dark in comparison with remainder of wing (although browner than orbicular spot), orbicular spot usually nearly round and not oblique; both spurs on middle leg very slender, the specialized setose areas much reduced to single, longitudinal, line-like areas (figure 274)....**exigua** (Huebner).

#### Females

- 4(1). Fore wing with reniform spot nearly black, appearing as a sharply contrasting black spot to the unaided eyes; fore tibia with a comparatively heavy mass of long hair and scales on outer side, and breadth across tibia including the vestiture greater than length of first tarsal segment, and also greater than second and third segments combined, the longer hairs and scales extending down to about middle of first tarsal segment .....**mauritica acronyctoides** (Guenée).

Fore wing with reniform spot not black and not very outstanding; fore tibia with a comparatively light mass of hairs and scales on outer side so that extreme breadth across tibia including vestiture is much shorter than first tarsal segment, and also shorter than tarsal segments two plus three.....5

- 5(4). Fore wing with orbicular spot elongate ovate, strongly oblique, in some examples approaching reniform spot in length.....**exempta** (Walker).

Fore wing with orbicular spot round or at most shortly ovate, usually not oblique, much smaller than reniform spot.....**exigua** (Huebner).

**Spodoptera exempta** (Walker), new combination (figs. 274, 275, 276, 278, 280, 282, 283).

*Agrotis exempta* Walker, 1856:355.

*Prodenia bipars* Walker, 1857:724.

*Prodenia ingloria* Walker, 1858:1679. Butler, 1877:47; 1880:7.

*Laphygma exempta* (Walker) Hampson, 1909:261, pl. 128, fig. 24.

Misidentified as *Spodoptera mauritia* (Boisduval) in Hawaii prior to 1938; see Swezey, 1938:75. This early record stems from misidentifications by Meyrick (1899:152, 1904:347) and by Hampson (1909:256–258), who listed a female from Kona; this specimen has been checked in the British Museum and the identification corrected.

The nutgrass armyworm.

Kauai, Niihau, Oahu, Maui, Lanai, Hawaii, French Frigate Shoal, Pearl and Hermes Reef, Johnston.

Immigrant. Nearly cosmopolitan; widespread in the Pacific. First recorded from Hawaii, as *Prodenia ingloria*, by Butler (1877:47) from specimens collected by Blackburn.

Hostplants: Beans, *Cenchrus echinatus*, *Chloris radiata*, *Chloris* species, corn, *Cynodon dactylon* (Bermuda grass), *Cyperus rotundus* (nut grass), *Eragrostis*, *Eleusine indica*, *Eleusine* species, *Panicum cinereum*, *Panicum nephelophilum xerophilum*, peas, potato, *Sida*, sugarcane, tomato, *Xanthium*.

Parasites: *Apanteles margineventris* Cresson, *Archytas cirphis* Curran, *Chaetogaedia monticola* (Bigot), *Eucelatoria armigera* (Coquillett), *Hyposoter exiguae* (Viereck), *Meteorus lahygmae* Viereck, *Metarrhizium anisoplia* (a fungus), *Pseudamblyteles koebelei* (Swezey), *Pterocormus purpuripennis* (Cresson), *Telenomus nawai* Ashmead, *Trichogramma minutum* Riley.

Predators: English sparrow, golden plover, mynah bird, *Polistes* wasps.

For many years, this species has been a pest in Hawaii. It is mostly held in control by its natural enemies today, but outbreaks still occur from time to time, and range grasses are sometimes subject to heavy attack until the parasites build up their pressure. Its attacks on sugarcane today are minor compared to the major damage it once did annually. However, sugar plantation personnel occa-

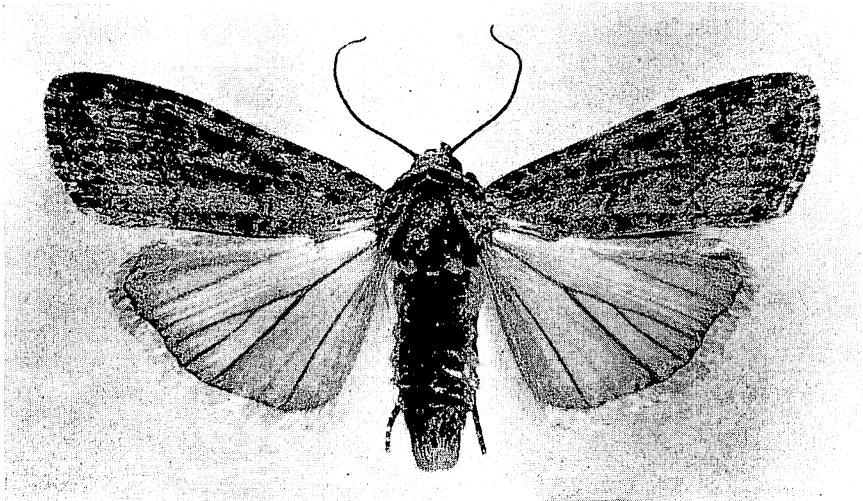


Figure 277—*Spodoptera exigua* (Huebner), Honolulu; expanse, 32 mm. Reared from potato.



sionally call for the services of entomologists in certain areas where minor outbreaks occur nearly every year. DDT sprays are effective in controlling the caterpillars.

Its caterpillars were formerly a very serious pest on the grass lands and cane fields of the Hawaiian Islands; but their numbers were greatly reduced by the introduction of the Mynah bird. Now they are no longer a serious pest, though they are often numerous in grass, where the Mynah birds may be seen searching for them; but before the Mynah bird was introduced, it is reported that often whole fields of young sugar cane were eaten by them; and that the grass slopes in the valleys and mountains would be entirely consumed by them at times; in fact, they were in millions and behaved much like army worms. (Swezey, 1907:13.)

One of the best checks to the increase and ravages of the army worms is the Mynah bird. This bird was introduced from India about twenty or more years ago, for the purpose of feeding upon army worms and cutworms. Although it has some other undesirable habits, yet it is very valuable for this purpose. It has increased probably to its maximum limit, and is perhaps at present somewhat reduced in numbers on account of the lack of Lantana berries which at one time formed a large part of its diet.

It is to be found practically everywhere throughout the Islands, at least the habitable and cultivable portions. With its increase has come the decrease in devastation by army worms and cutworms; whereas previously it is reported that whole fields of young cane were stripped off by the great numbers of caterpillars, and that grass lands of great areas were likewise totally eaten off, particularly by the grass army worm . . . in recent years the damage has been slight compared with formerly. (Swezey, 1909:23-24.)

Perkins (1913:cxlviii) noted that during the winter months the caterpillars formed a "favourite and important food-supply of the golden plover."

The eggs . . . are spherical, slightly flattened at base where in contact with the object upon which they are deposited. They are dirty whitish or gray in color, and densely striated vertically. They are usually in large masses of one layer and in regular rows, and covered with gray hairs from the abdomen of the moth. There may be from 100 to 300 in one cluster. One moth may lay several hundred eggs; one specimen which I had in a breeding cage laid 700. The egg masses are not placed necessarily on the food plant; but usually high up, often on the leaves of banana and small palms, or other small trees or shrubs at three to five feet elevation. It is also common to find them on the sides of buildings and other structures. In one instance I found a batch of eggs ten feet up on the side of a building. The eggs hatch in three to four days from the time they are laid, and the tiny larvae drop to the ground by means of a silken thread, where they will find grass or other suitable food plant. They feed first at the tips of the leaves, eating the green substance of the leaf and leaving the epidermis, which dries up, giving a dead appearance. When a few days old, they eat the entire substance of the leaf from its margins, producing notches and a very ragged appearance.

After molting five times at intervals of two to six days, the caterpillars become full-grown in two to three weeks. . . . They are then about 1.3 inch long (35 mm.). They vary a great deal in coloration. Some are nearly uniform grass green with median dorsal and sub-dorsal white lines; others are nearly black, with a sub-dorsal stripe and a stripe on line with spiracles darker than the rest, and a yellowish (sometimes pinkish) stripe below spiracles, underside pale. There are all gradations between these two. A common form is green with the sub-dorsal and spiracular stripes black; another form has the stripes broken up into a series of black spots, one spot to each segment. The spiracles are always black, and in the black form there is a white dot a little above and behind the spiracle on segments 5 to 12. Hairs minute. Tubercles inconspicuous.

The pupa is formed in an earthen cell a little below the surface of the soil. It is medium brown, a little more than half an inch in length (12 to 15 mm.). At its apex are two straight slender-pointed spines set rather wide apart and nearly parallel.

The moth emerges from the pupa in eight to fourteen days, and is ready for egg-laying in two to four days. Thus the whole life cycle occupies only five to six weeks. With the wings spread, the moth is 1.25 to 1.50 inches (30 to 35 mm.). The fore wings of the female are a dark gray with darker wavy lines crossing at one-third and two-thirds from the base, a row of triangular black dots on terminal margin, and two or three marks a little before terminal margin. A little before middle of wings is an oval yellow spot. The hind wings are whitish with brown on margins and veins. . . . The forewings of the male are much paler than those of the female and have varying shades of very pale brown; the lines and markings are more distinct. (Swezey, 1909:14-15.)

In describing an attack of the larvae on sugarcane seedlings, Swezey (1909:14) had the following to say:

It required daily examinations, and careful search, for the tiny larvae were green like the leaves; and although small, yet were big enough for one of them to soon destroy one of the little cane seedlings (which were 1-2 inches high) if not detected soon after it had started feeding. Fortunately they did not work after the manner of cutworms and cut a plant off immediately. Instead, they began eating at the tips of leaves, and they could be first detected by the dried remains of tips of leaves where they had fed, then closer looking would reveal the tiny green caterpillar, which on being disturbed dropped to the ground. . . . Usually but one caterpillar was found on one seedling; but sometimes more, even as many as four, in which case they soon destroy the plants.

Dr. Swezey made some preliminary experiments in breeding the moths for color variation in 1908:166-167, and other notes are to be found in Swezey, 1906:57-58. Also, see Williams, 1931:136-140.

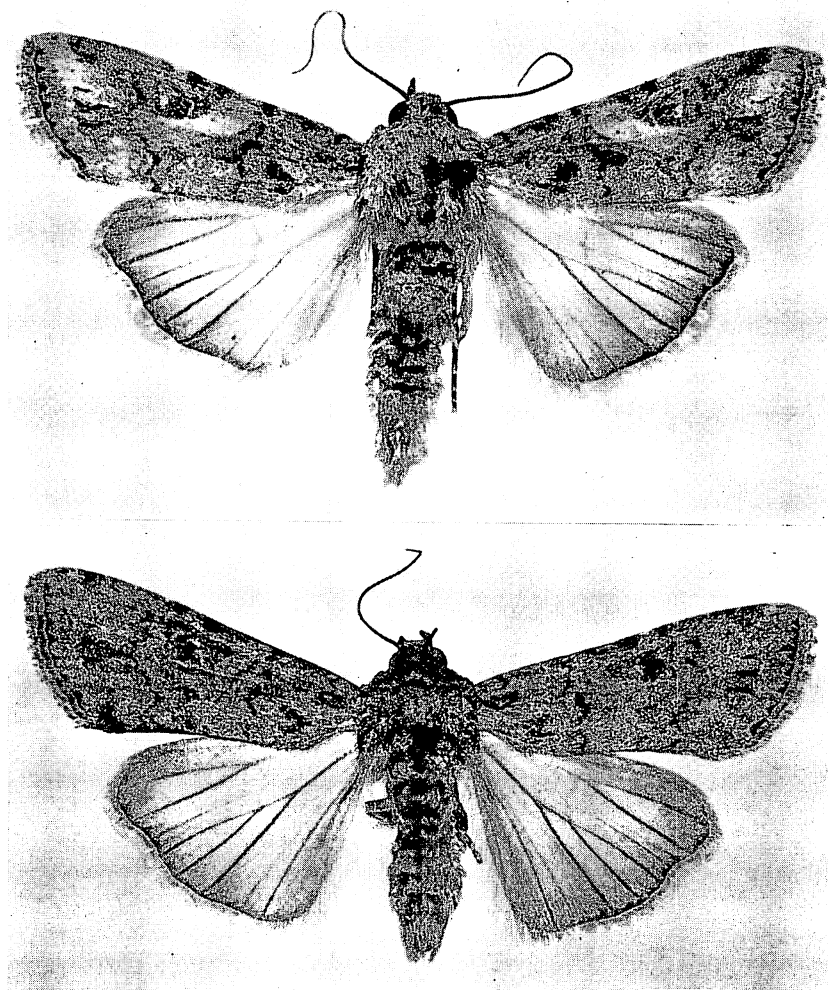


Figure 278—*Spodoptera exempta* (Walker), a male (top) and female from Puunene, Maui, illustrating difference in color pattern; both 33 mm. in expanse. The male has been compared with the type in the British Museum (Natural History).

***Spodoptera exigua* (Huebner), new combination** (figs. 273, 274, 275, 276, 277, 280, 281).

*Noctua exigua* Huebner, 1808:fig. 362.

*Caradrina venosa* Butler, 1880:7.

*Laphygma exigua* (Huebner), Chittenden, 1902:37-46, figs. 8-9. Hampson, 1909:265, fig. 68. Fletcher, 1914:378, fig. 240.

Crumb, 1956:224, larva.

For extensive synonymy see Hampson, 1909:265, fig. 68.

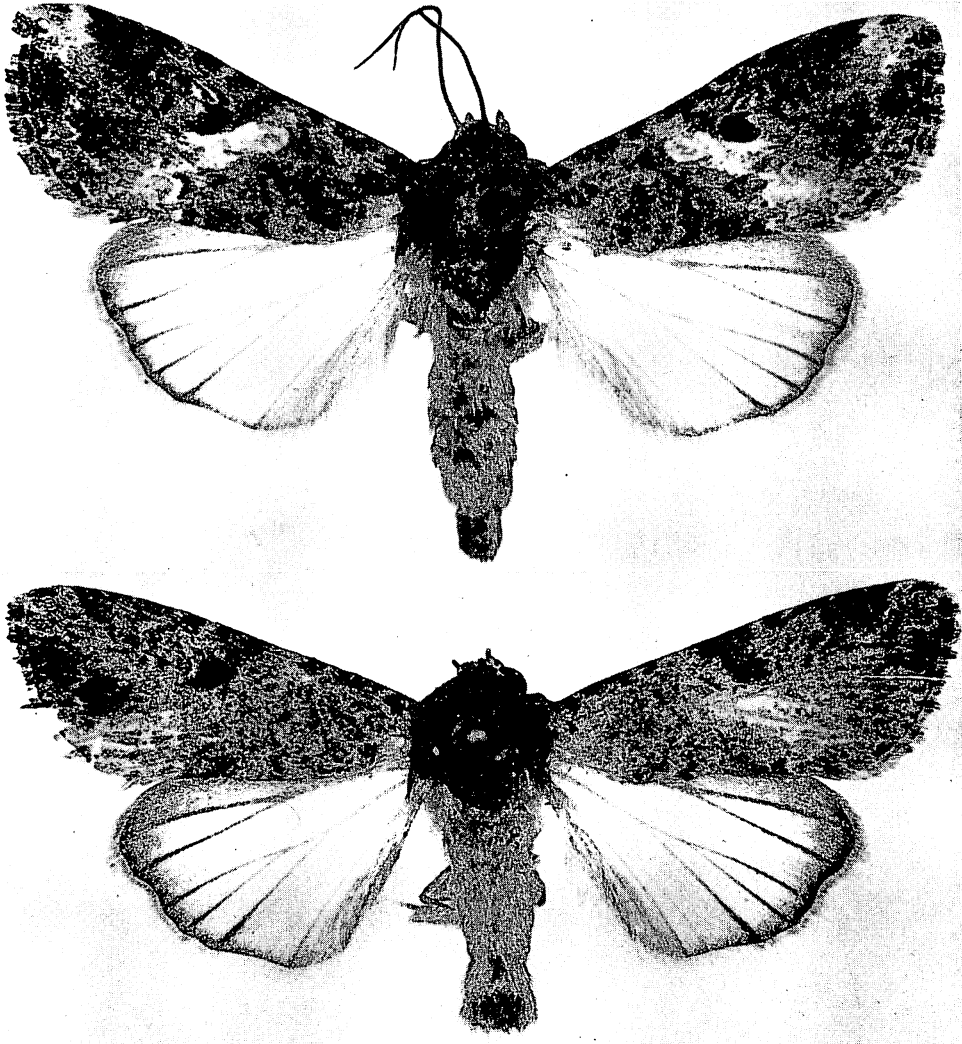


Figure 279—*Spodoptera mauritia acronyctoides* (Guenée). Above: Male; expanse, 28.5 mm. Below: Female; expanse, 31.5 mm. Both specimens are from Honolulu.

The beet armyworm.

Kauai, Oahu, Maui, Hawaii.

Immigrant; nearly cosmopolitan. First reported from Hawaii by Butler (1880: 7).

Hostplants: Alfalfa, amaranth, aster, bean, beet, broccoli, cabbage (Chinese and head), carrot, corn, *Datura*, *Euxolus*, grasses, lettuce, *Nicotiana glauca*, onion, pea, pepper, potato, *Ricinus communis*, *Sonchus*, soybean, spinach (Chinese), sunflower, sweetpotato, tomato.

Parasite: *Frontina archippivora* (Williston).

Predator: Mynah bird.

This species is not as common an insect as is *Spodoptera exempta*, and we do not know as much about it.

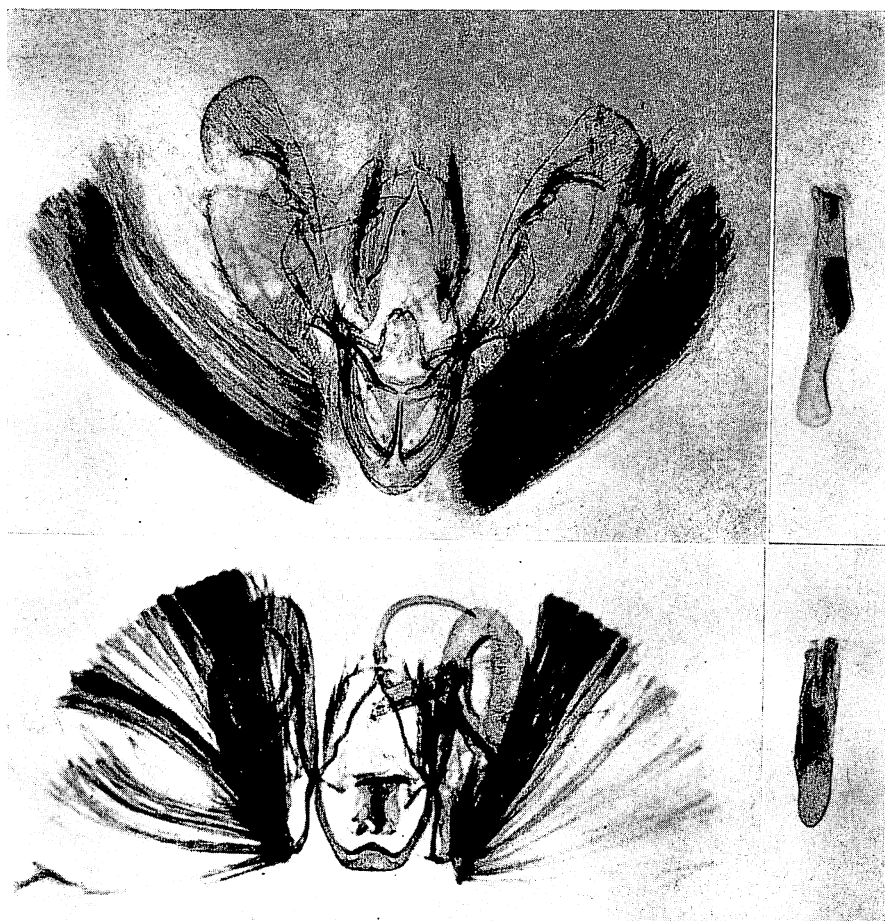


Figure 280—Male genitalia of *Spodoptera*. Above: *exempta* (Walker); Honolulu. Below: *exigua* (Huebner); Kona, Hawaii.

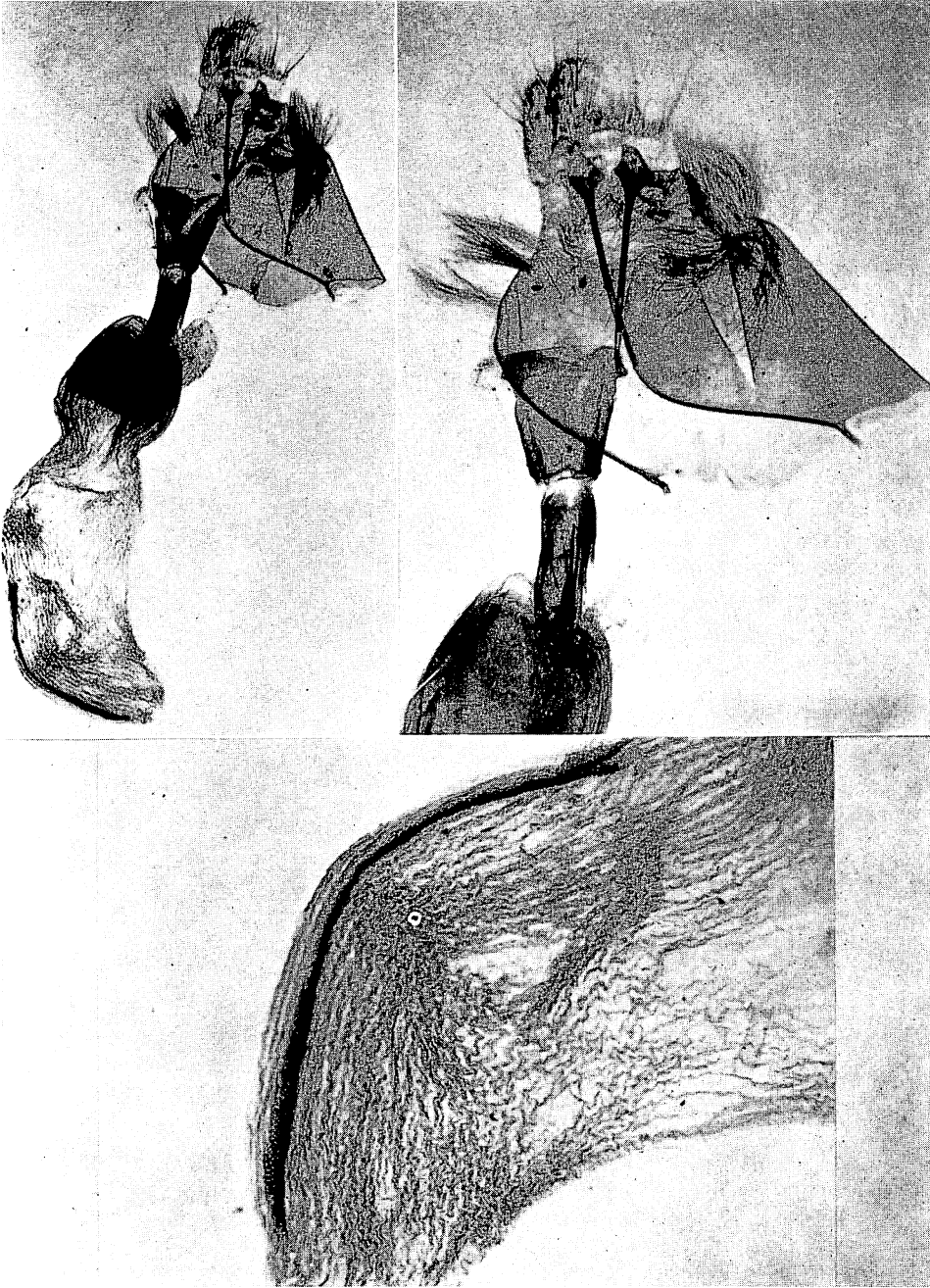


Figure 281—Female genitalia of *Spodoptera exigua* (Huebner). From the type of the synonym *Caradrina venosa* Butler, from Honolulu.

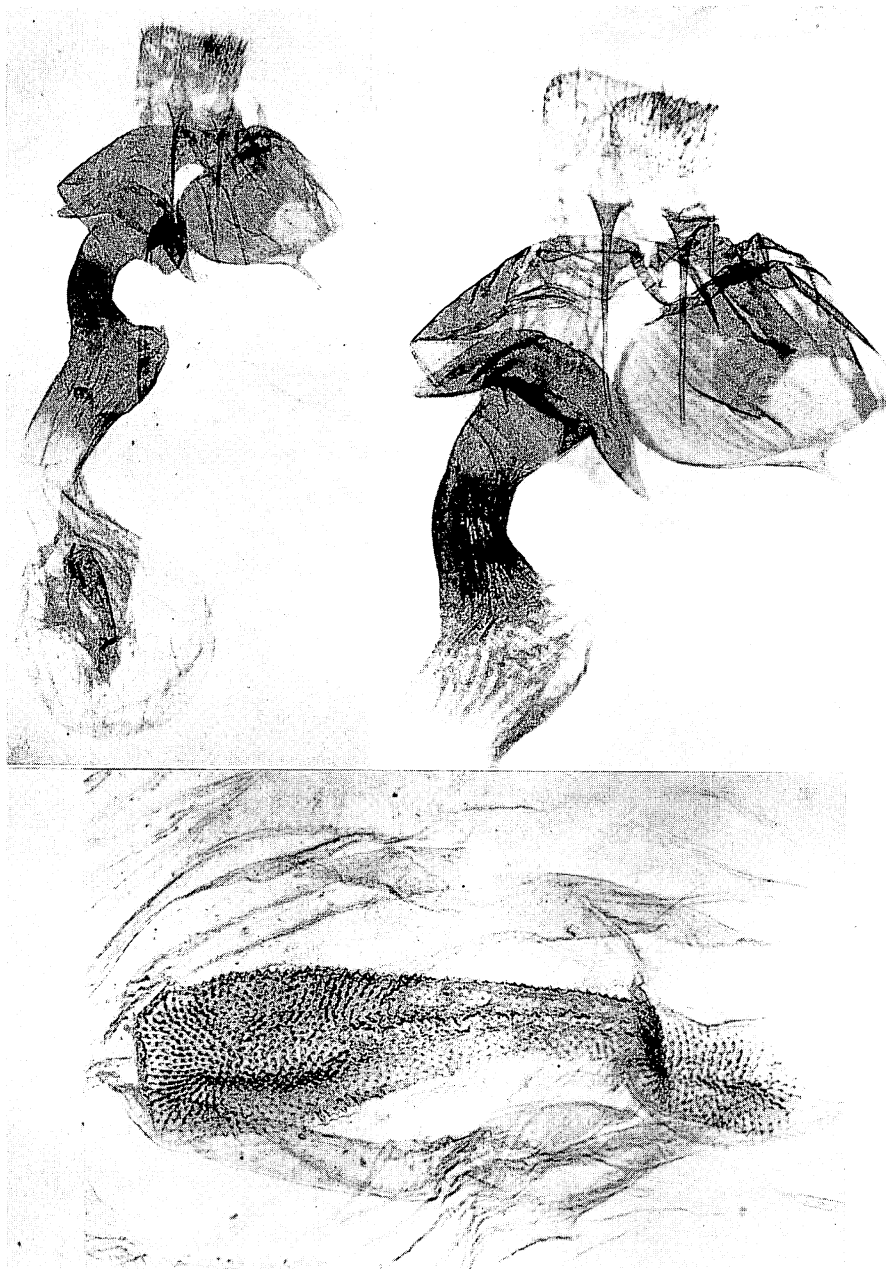


Figure 282—Female genitalia of a Honolulu example of *Spodoptera exempta* (Walker).

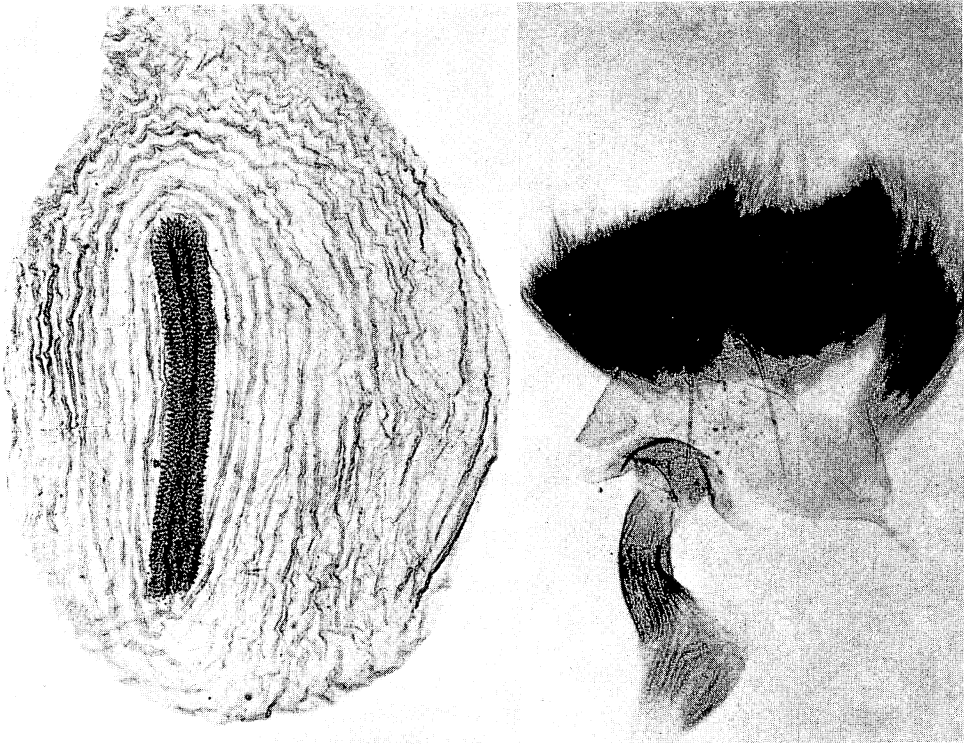


Figure 283—Part of female genitalia of *Spodoptera exempta* (Walker) for comparison with figure 282. The dense tufts surrounding the ovipositor have been only partly removed here. This is a virgin from Oahu.

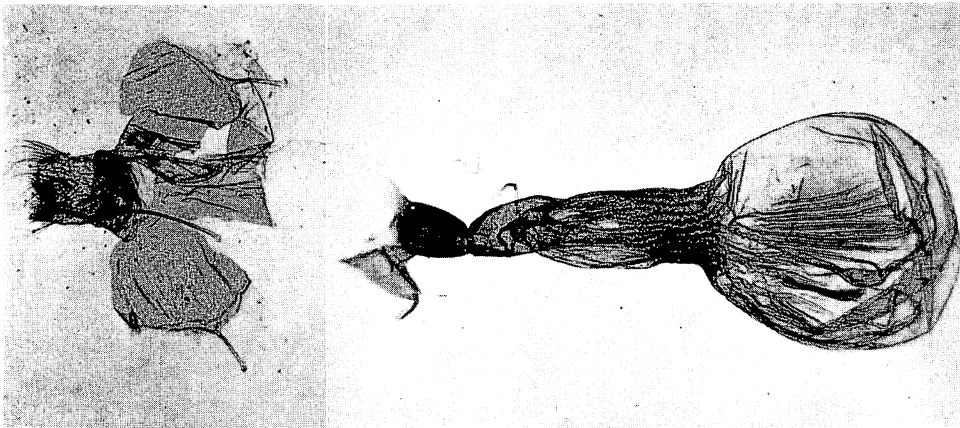


Figure 284—Female genitalia of *Spodoptera mauritia acronyctoides* (Guenée).



The egg clusters were on the upper surface of a leaf. In one cluster, 40 eggs were counted. They were spherical, in regular rows, one layer deep, and the cluster densely covered with greyish hairs from the body of the moth.

One cluster of 100 was found which had just hatched. The larvae were two mm. long, green with black heads, and finely pubescent, each hair in a tiny black tubercle.

While young they fed gregariously on the upper surface of a leaf along a vein where the leaf was somewhat depressed, and they ate only the green substance of the leaf, leaving the lower epidermis. They were covered by a slight web. As they increase in size they become more separated, often feeding singly, but protected by a web, tho not always. Finally, when about full grown, they were found without the protecting web; and they ate the leaf entirely, making ragged holes, not leaving the lower epidermis.

The ground color of the upper surface of a larva 12 mm. long is black, with fine longitudinal, crinkly, much interrupted lines of yellowish; there are three nearly complete yellow lines on dorsal side, the middle one forking on the head; a broad yellowish line just below the level of the spiracles; there is a row of white dots on each side, one dot behind and a little above each abdominal spiracle; under side paler than upper.

A larva somewhat larger had the same markings except that the yellowish lines have become greenish. As they become older, there is quite a variation in the degree of coloration, often the green predominates, and an occasional specimen is almost entirely black, but all have a black line on the level of the spiracles; the mid-dorsal pale line is nearly obliterated; spiracles are brownish, with black borders.

The pupa is 12 mm. long; medium brown, with some greenish on wing and legcases; smooth, except a punctate band on anterior margin of segments 4, 5, 6, 7 of abdomen; abdominal spiracles black, very slightly raised; cremaster two sharp-pointed spines. (Swezey, 1906:55-56.)

The pupal period was found to be 12 to 17 days; the pupa is formed underground. For illustrations, see Peterson, 1948:182, figs. L37, A-D.

The caterpillars were reported by Browne (*Proc. Hawaiian Ent. Soc.* 10(1):24, 1938) to have destroyed about a quarter of a crop of onions on Oahu by feeding inside the hollow stems.

Swezey (1937:433) found that Paris green added to Bordeaux mixture used to prevent blight on potato also controlled the attacks of this species.

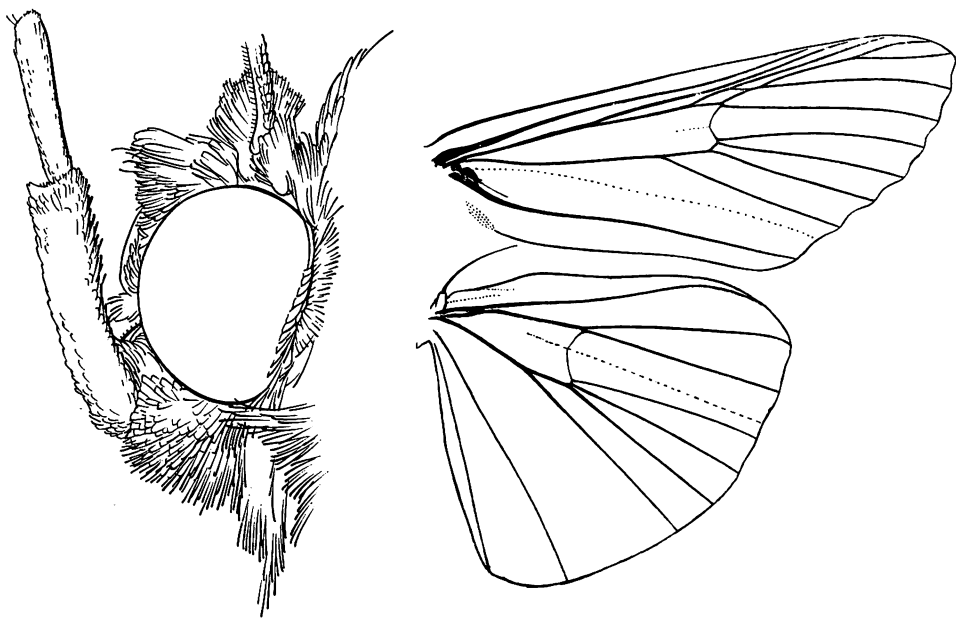


Figure 285—Head (left) and wing venation (right) of *Stictoptera subobliqua* (Walker).



***Spodoptera mauritia acronyctoides*** (Guenée) (figs. 273, 274, 275, 276, 279, 284).

*Spodoptera acronyctoides* Guenée, 1852:154.

For synonymy, see Fletcher, 1956:216, pl. 6, figs. 2–5. See also, Hampson, 1909:256, fig. 56; Rebel, 1910:424; Tams, 1935:200.

Oahu.

Immigrant. Widespread from the Red Sea to India, Burma, Ceylon, Malaya to Australia and widespread in the Pacific Islands, including the Solomons, New Hebrides, Fiji, Samoa, Society, Austral, Marquesas and Marshall Islands. First caught in Hawaii at a light trap at Barbers Point air station in December, 1953. Prior to 1938, *Spodoptera exempta*, which see, had been confused under the name *Spodoptera mauritia* in Hawaii.

Hostplants: Grasses.

These caterpillars rapidly became pests of lawns in Hawaii soon after establishment. For a colored plate of egg, larvae, pupa, adults and damage, see Fletcher, 1914:378, pl. 20.

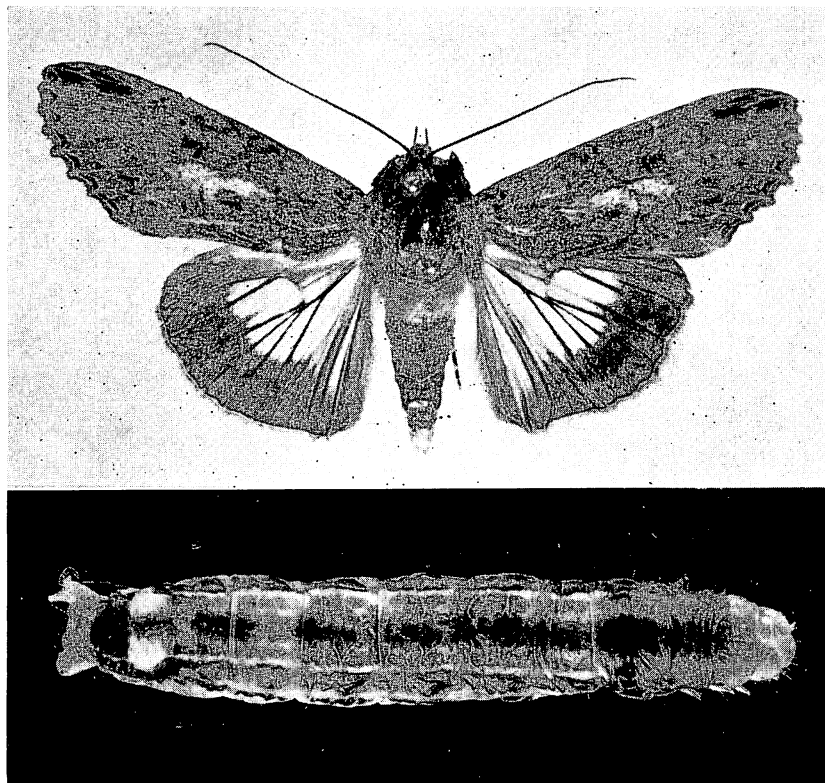


Figure 286—*Stictoptera subobliqua* (Walker); Honolulu; expanse, 45 mm. Below: Dorsal view of larva.

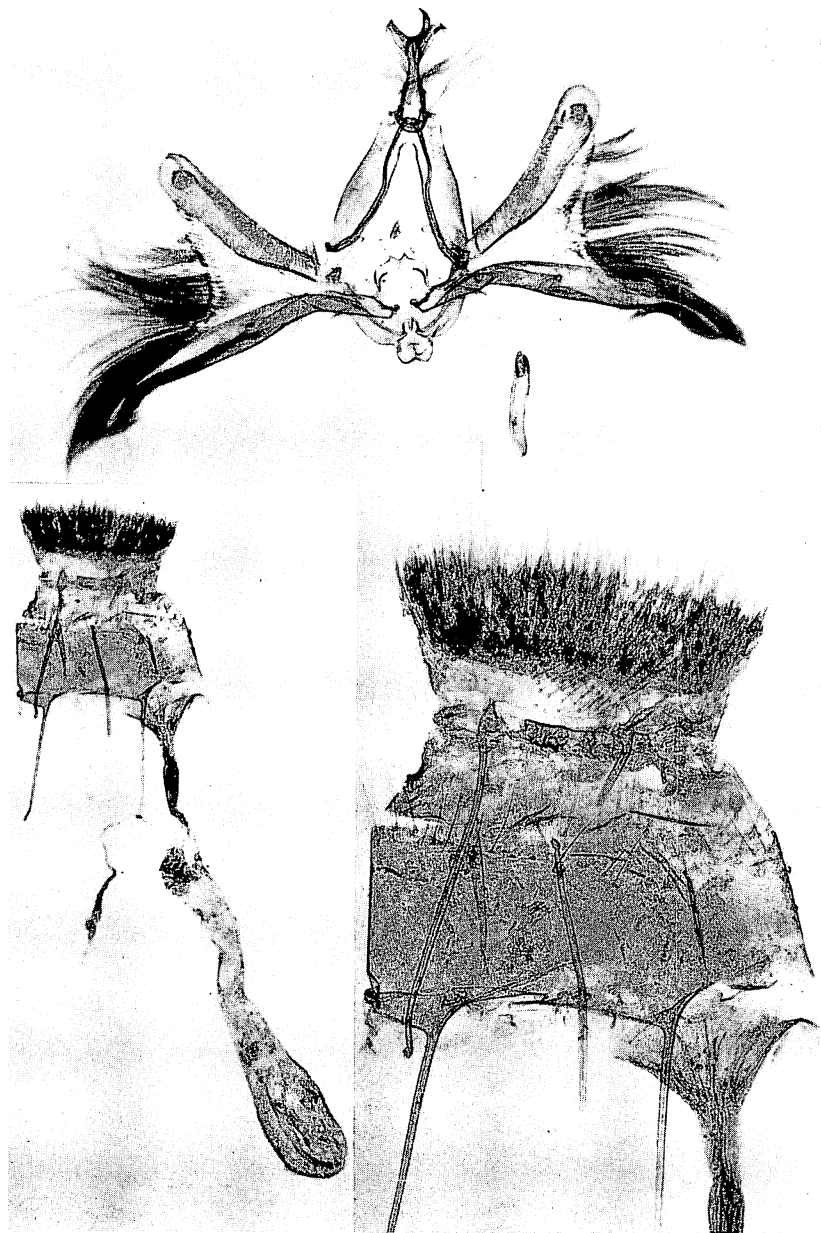


Figure 287—Male (above) and female (below) genitalia of *Stictoptera subobliqua* (Walker). Male from Honolulu; female, the type from Ceylon.

*Spodoptera mauritia mauritia* (Boisduval, 1833:240; 1833:92, pl. 13, fig. 9) Guenée, 1852:153, appears to be confined to Mauritius, Madagascar and vicinity and parts of Africa. For description and discussion, see Fletcher, 1956:215, pl. 1, figs. 1, 4, 8, 11, 12.

Subfamily STICTOPTERINAE

*Stictopterinae* Hampson, 1912:141.

*Odontodinae* Hampson, 1918:383.

Genus **STICTOPTERA** Guenée, 1852

**Stictoptera subobliqua** (Walker) (figs. 285, 286, 287).

*Steiria subobliqua* Walker, 1857:1136.

*Steiria variabilis* Moore, 1882:164.

*Stictoptera subobliqua* (Walker) Moore, 1885:121, pl. 159, figs. 4, 4a, 4b.

Oahu, Molokai, Maui, Hawaii.

Immigrant. Described from Ceylon; widespread from India through Malaysia. First recorded in Hawaii in 1949 by P. Weber from specimens taken in Honolulu in 1948.

Hostplants: *Calophyllum inophyllum*, *Clusia rosea*, *Garcinia cambogia*, *Mamea americana*.

Swezey found the larval period to be 15 days and the pupal period to be 10 to 12 days.

This is a highly variable moth.

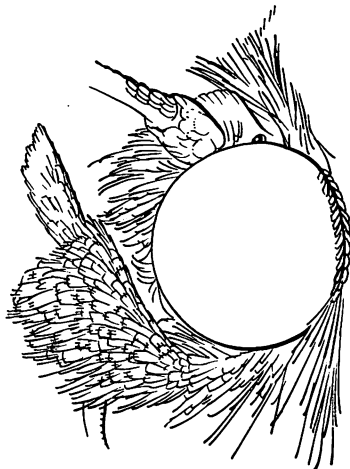


Figure 288—Head of *Amyna natalis* (Walker).

## Subfamily ERASTRINAE

*Erastridae* Herrich-Schaeffer, 1851:402. Guenée, 1852:224.

*Erastrinae* Hampson, 1910:1-829.

Genus **AMYNA** Guenée, 1852

***Amyna natalis*** (Walker) (figs. 288, 289, 290, 291).

*Berresa natalis* Walker, 1858:214.

*Miana palpalis* Walker, 1865:678.

*Amyna natalis* (Walker) Rebel, 1915:126. Hampson, 1910:461, fig. 131, and synonymy.

Oahu.

Immigrant. Described from Ceylon and widely distributed from India through the Indo-Pacific to Polynesia. First reported from Hawaii by Swezey in 1946 from examples taken at light traps near Pearl Harbor in 1945.

Hostplants: *Abutilon incanum*, *Sida cordifolia*, *Sida fallax*, *Sida rhombifolia*, *Waltheria americana*.

Parasites: *Eucelatoria armigera* (Coquillet), *Hyposoter exiguae* (Viereck), *Meteorus lahygmae* Viereck.

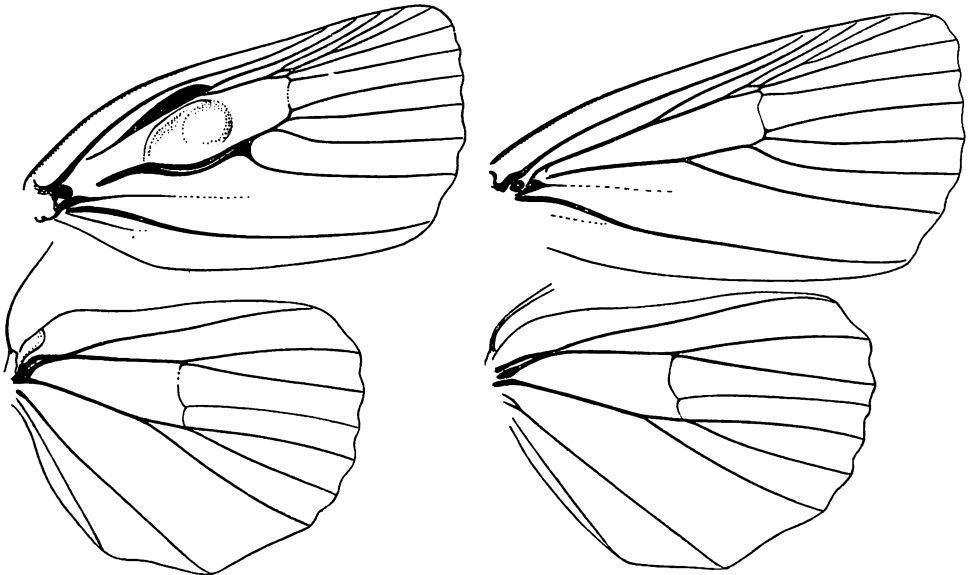


Figure 289—Wing venation of male (left), and female (right), *Amyna natalis* (Walker). Both examples from the type series from Ceylon.

The male has a peculiar pocket on the fore wing, and the genitalia have some unusual types of setae (see Richards, 1938:91, for notes on these setae). The caterpillars are green loopers.

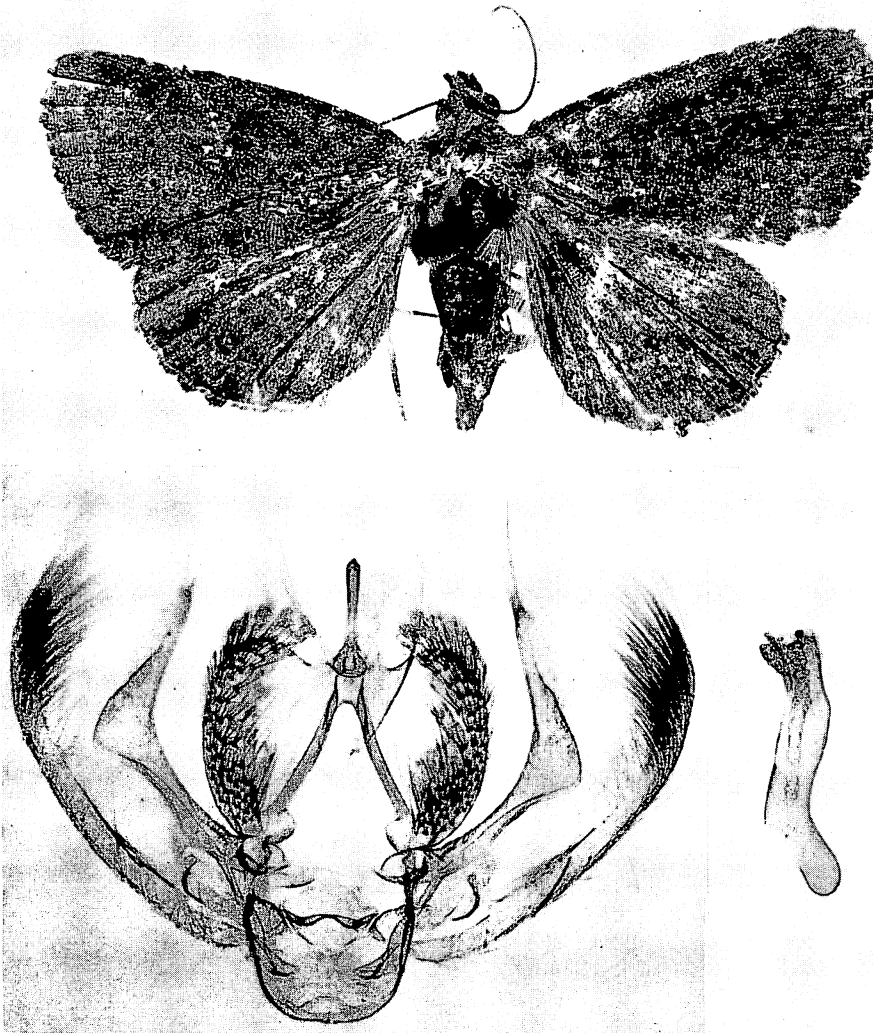


Figure 290—*Amya natalis* (Walker). A female from Waipio, Oahu (above); expanse, 21 mm. compared with the female type. The scales are somewhat rubbed, and the photograph appears to indicate a specimen darker than it should be. The genitalia of a male from the type series from Ceylon are at the bottom.

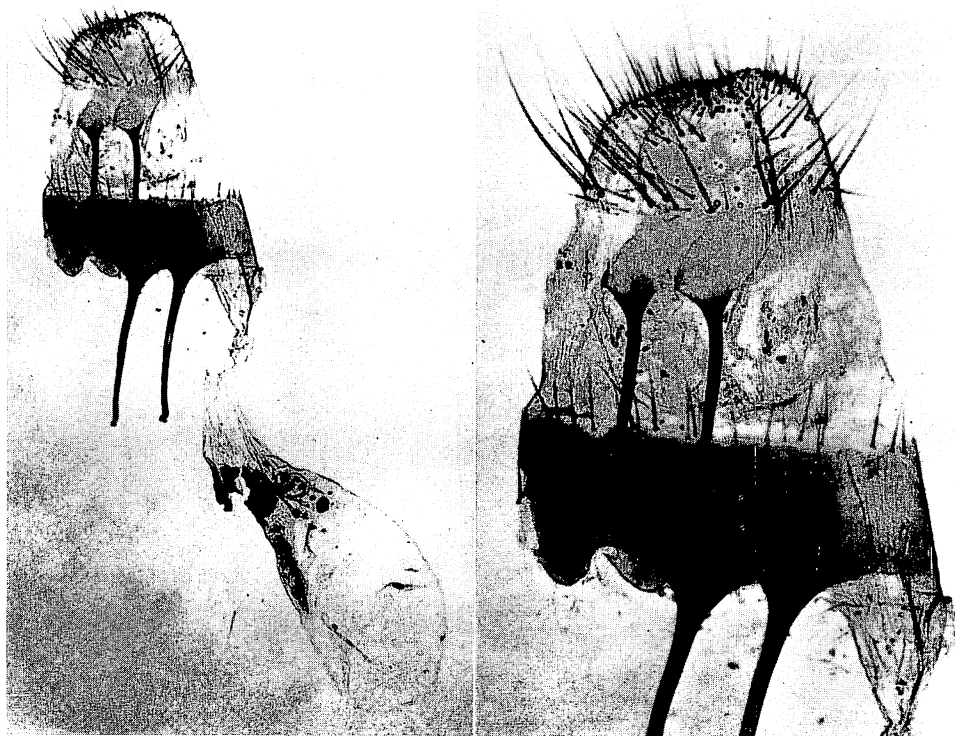


Figure 291—Female genitalia of *Amyna natalis* (Walker). From the type series from Ceylon.

Genus **BOCANA** Walker, 1858:170

*Lamura* Walker, 1858:189.

*Bithiasa* Walker, 1865:1116.

**Bocana manifestalis** Walker, type of *Bocana* (figs. 292, 293, 294).

*Bocana manifestalis* Walker, 1858:171.

*Diomea repulsa* Walker, 1865:899.

*Bithiasa determinata* Walker, 1865:1116.

*Lamura oberratalis* Walker, 1858:189.

*Adrapsa manifestalis* (Walker), of authors.

Kauai, Oahu, Molokai, Hawaii.

Immigrant. Widespread from India through the Pacific. I do not know when the first specimens of this species were found in Hawaii, but the first mention of it in our literature was by Swezey in *Proc. Hawaiian Ent. Soc.*, 1910:133, although Perkins (1913:cxlviii) said that the species was introduced from Fiji and "not noticed until after 1902."

Hostplants: "Grasses and weeds" (Swezey, in the above reference).

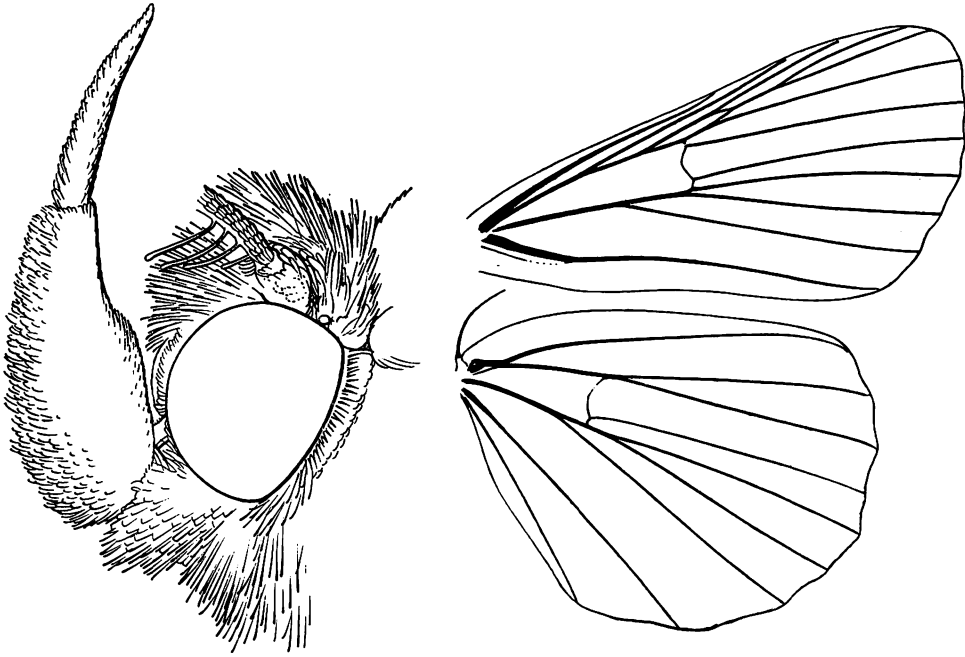


Figure 292—Head (left) and wing venation (right) of *Bocana manifestalis* Walker.

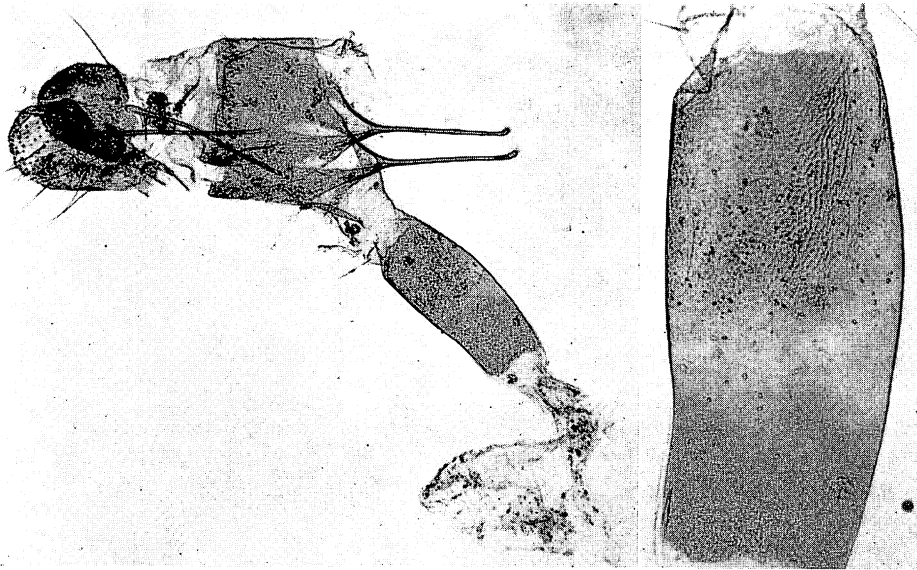


Figure 293—Female genitalia of *Bocana manifestalis* Walker, Hakalau, Hawaii.

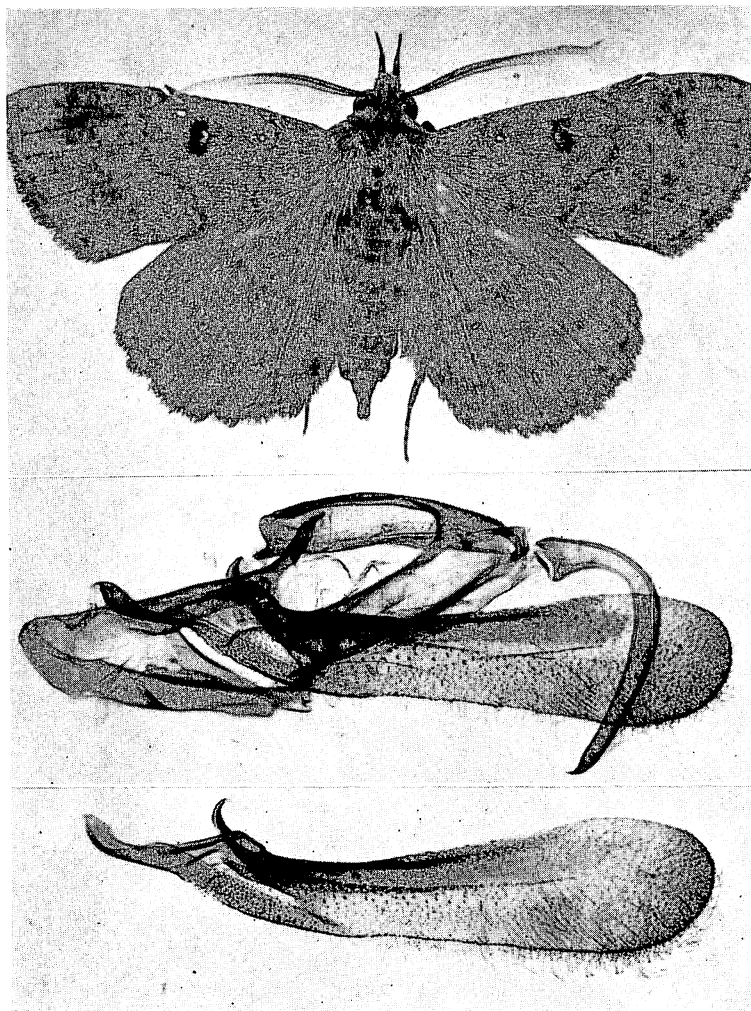


Figure 294—*Bocana manifestalis* Walker; Mt. Tantalus, Oahu; expanse, 38 mm. Male genitalia from a specimen from Hakalau, Hawaii.

Subfamily CATOCALINAE

*Catocalides* Boisduval, 1833:99; 1840:166.

*Catocalidae* Guenée, 1852:79.

Mosher (1916:117) noted that "This group is distinguished from all other noctuids [studied by her] by the presence of a whitish 'bloom' on the surface of the pupa, which is retained even in alcoholic specimens."



Genus **ACHAEA** Huebner, 1823

Achaea is a district of North Peloponnesus, Greece.

**Achaea janata** (Linnaeus) (figs. 295, 296, 297).

*Phalaena Geometra Janata* Linnaeus, 1758:527.

*Phalaena Noctua melicerta* Drury, 1773 (named in index, described on p. 46 and figured on pl. 23, fig. 1, 1770).

*Achaea argilla* Swinhoe, 1901:132.

*Ophiusa ekeikei* Bethuen-Baker, 1906:256.

*Achaea melicerta*, of Hampson, 1913:536. Fletcher, 1914:386, fig. 250.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. Widespread from India through Malaya and many Pacific islands to southeastern Polynesia. First found in Hawaii by F. X. Williams who discovered it in Honolulu in 1944, and it soon increased greatly in numbers and became widespread in Hawaii.

Hostplants: *Acacia farnesiana*, chili pepper, *Codiaeum*, cowpea, croton, daikon radish, *Desmanthus virgatus*, *Euphorbia bifida*, *Euphorbia geniculata*, *Euphorbia hirta*, *Leucaena glauca*, *Macadamia*, *Pedilanthus tithymaloides* (slipper flower), Philippine pole bean, *Poinsettia*, *Polypodium* (?), *Prosopis chilensis*, *Ricinus communis*, rose, *Terminalia catappa*, "wong bok" cabbage.

Parasites: *Chaetogaedia monticola* (Bigot), *Eucelatoria armigera* (Coquillett), *Hyposoter exiguae* (Viereck).

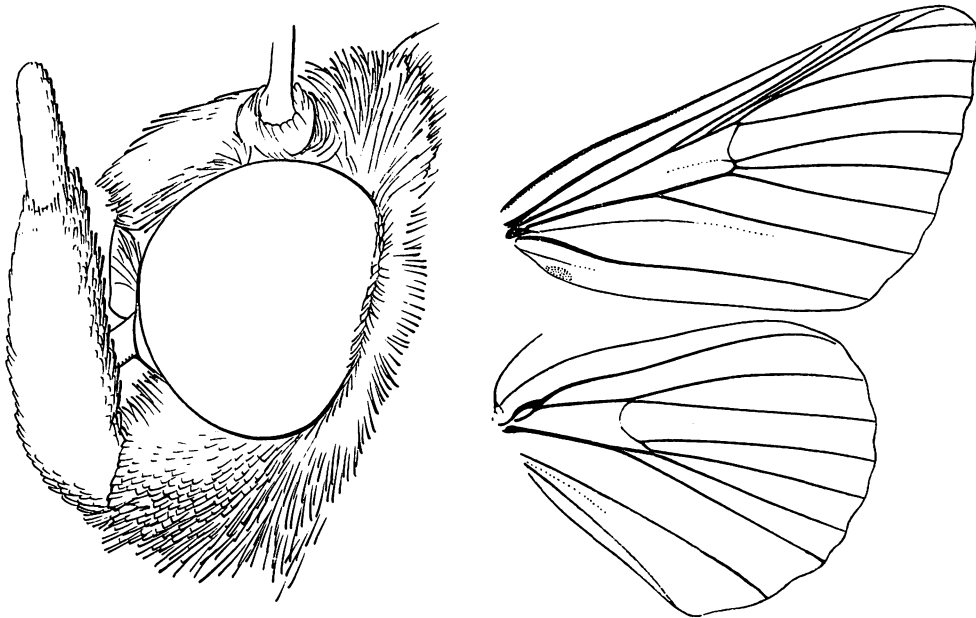


Figure 295—Head (left) and wing venation (right) of *Achaea janata* (Linnaeus).

Van Zwaluwenburg (1943:308) had the following to say about the species on Canton Island: "The larvae feed on the foliage of *Cordia subcordata*, and sometime eat shallow pits in the immature fruits. They vary in color from light tan to blackish, and have a transverse black marking on the back about a third of the

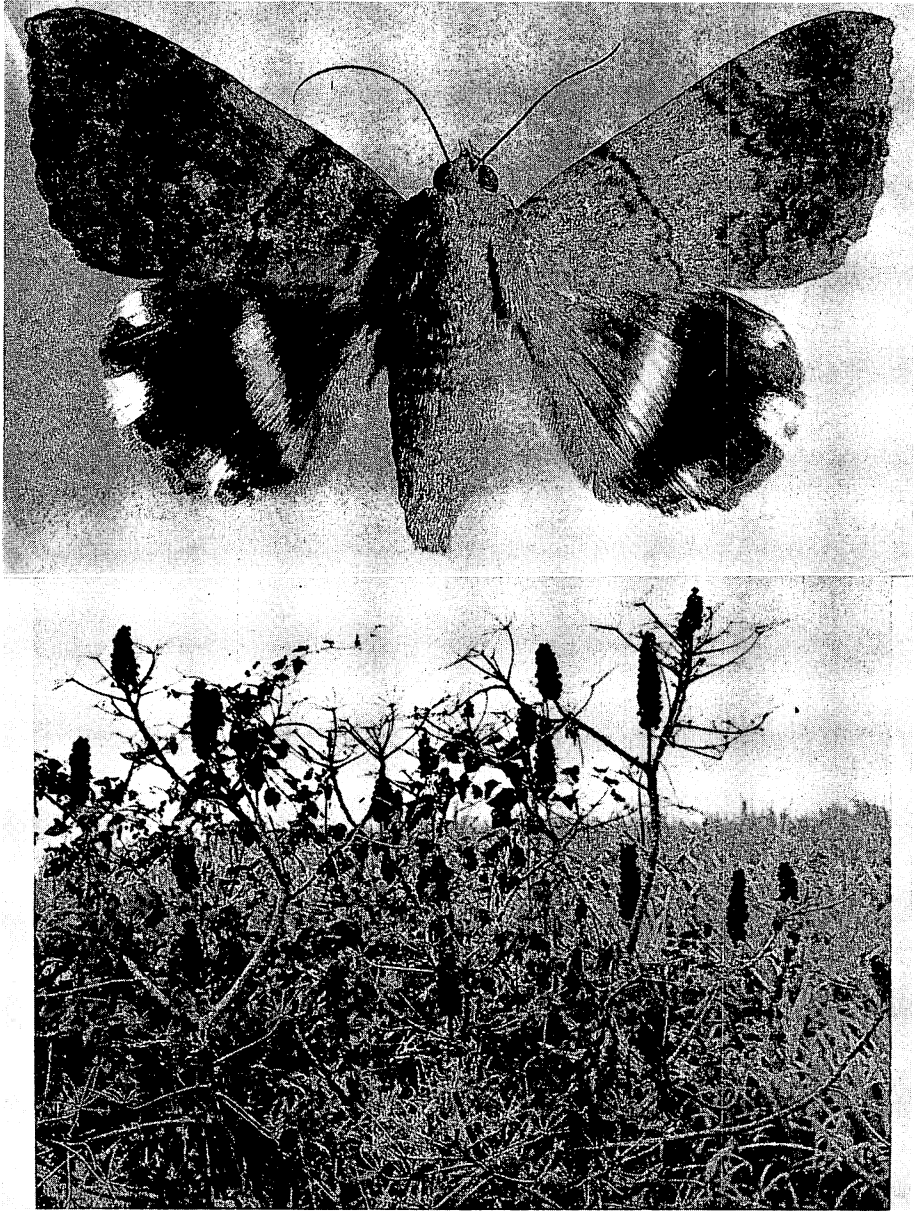


Figure 296—*Achaea janata* (Linnaeus) and castor bean plants stripped by the larvae.

way back from the head. When disturbed they lash about irritably and drop to the ground. Pupation is in a loose web within a leaf fold. Six individuals reared to maturity had a pupal period of from 8.5 to 11 days."

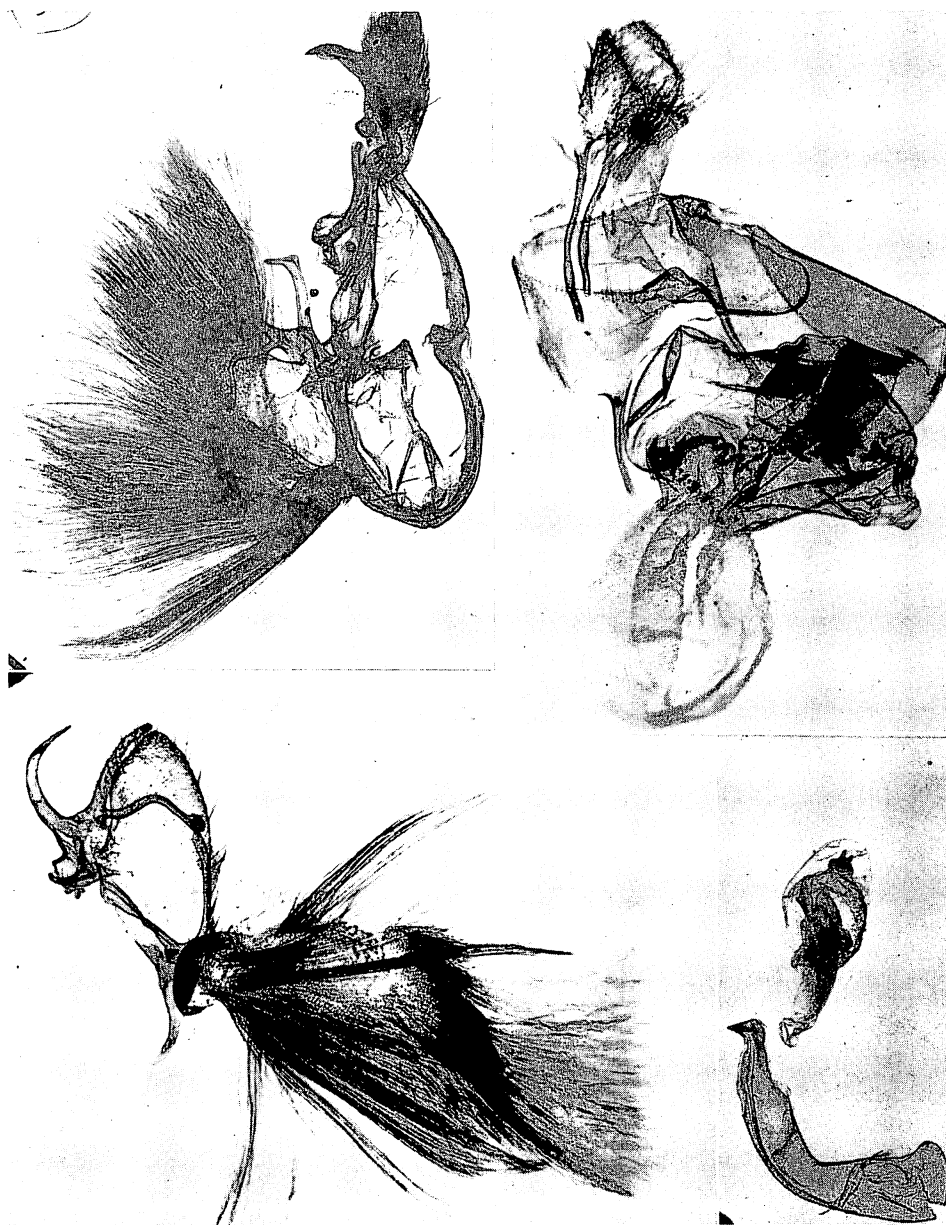


Figure 297—*Achaea janata* (Linnaeus). Above: Male genitalia (left) and female genitalia (heavily sclerotized) (right). Lower left: The right valve of the male genitalia. Lower right: The aedeagus with internal sac extruded. Marquesas Island specimens.

## Subfamily PLUSIINAE (Boisduval)

*Plusidi* Boisduval, 1829:91.

*Plusides* Boisduval, 1833:95; 1840:157.

*Plusiidae* Herrich-Schaeffer, 1851:390.

*Plusidae* Boisduval, 1852:319.

*Poaphilidae* Boisduval, 1852:293.

*Phytometrinae* Hampson, 1913:401. Mosher, 1916:115.

*Plusianae* Prout, 1921:2.

McDunnough, 1944.

All of the species of this subfamily have specialized bristles which project over the eyes in the manner of lashes. Our species all have white or pale metallic marks on the fore wings; the marks on some of the species are outstanding.

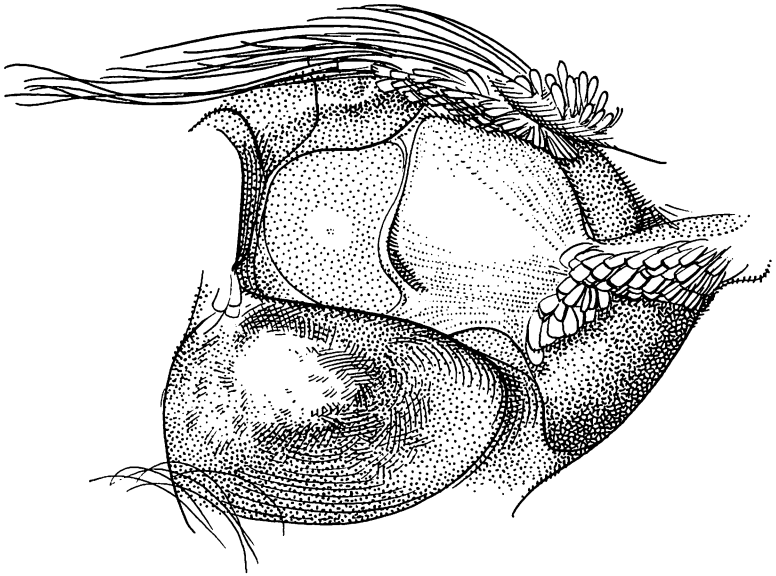


Figure 298—*Plusia* (*Autographa*) *biloba* (Stephens). An oblique, postero-lateral view of the thorax to show the right tympanum and associated areas.

Mosher (1916:115) who studied the pupae of this group in America, said: "The members of this subfamily differ markedly from those of the other subfamilies of Noctuidae. The labrum is never in its normal position but is located near the cephalic end of the body, while the wings and maxillae extend beyond the caudal margin of the fourth abdominal segment. The wings are produced into a sharp point near the meson of the ventral surface. . . ."

Genus **PLUSIA** Huebner

*Plusia* (Huebner, 1806: Tentamen, p. 2) Ochsenheimer, 1816:89. Type: *Phalaena* (*Noctua*) *chrysitis* Linnaeus, selected by Duponchel, 1829 (Curtis, 1832:731, erroneously cited *gamma* Linnaeus as type).

Considerable confusion exists in literature and collections regarding the generic name to use for this group. Some authors have referred the species to *Phytometra* Haworth, 1810(1809):254 (type: *Noctua aenea* Schiffermueller, selected by Bois-

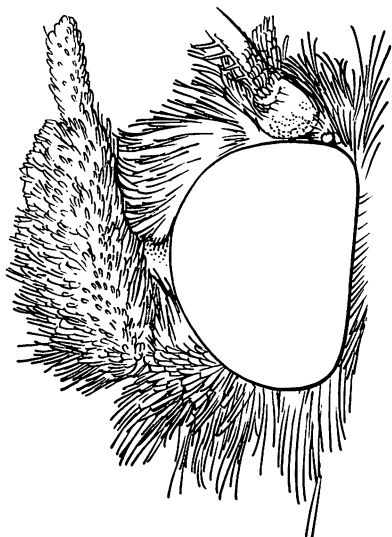


Figure 299—Head of *Plusia* (*Lophoplusia*) *pterygota* (Meyrick).

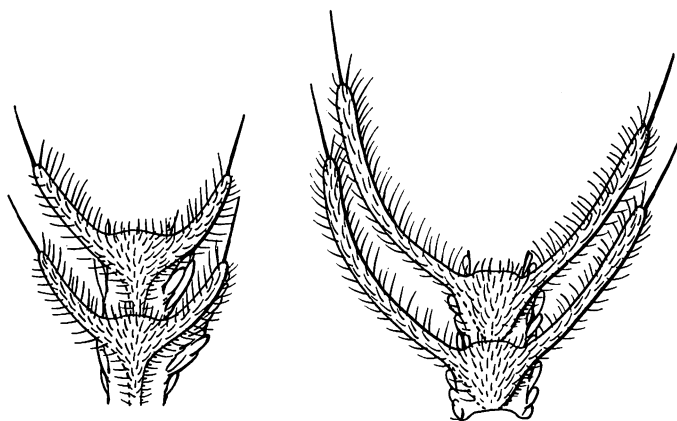


Figure 300—Ventral views of two antennal segments of *Plusia* (*Lophoplusia*) *psectrocera* (Hampson), male type (left), and *pterygota* (Meyrick), male type (right), to illustrate the bipectinate nature of the antennae in *Lophoplusia*.

duval, 1836 and Westwood, 1840), but *Phytometra* is a distinct genus whose type is quite a different kind of species than the type of *Plusia*. *Prothymia* Huebner is a synonym of *Phytometra*.

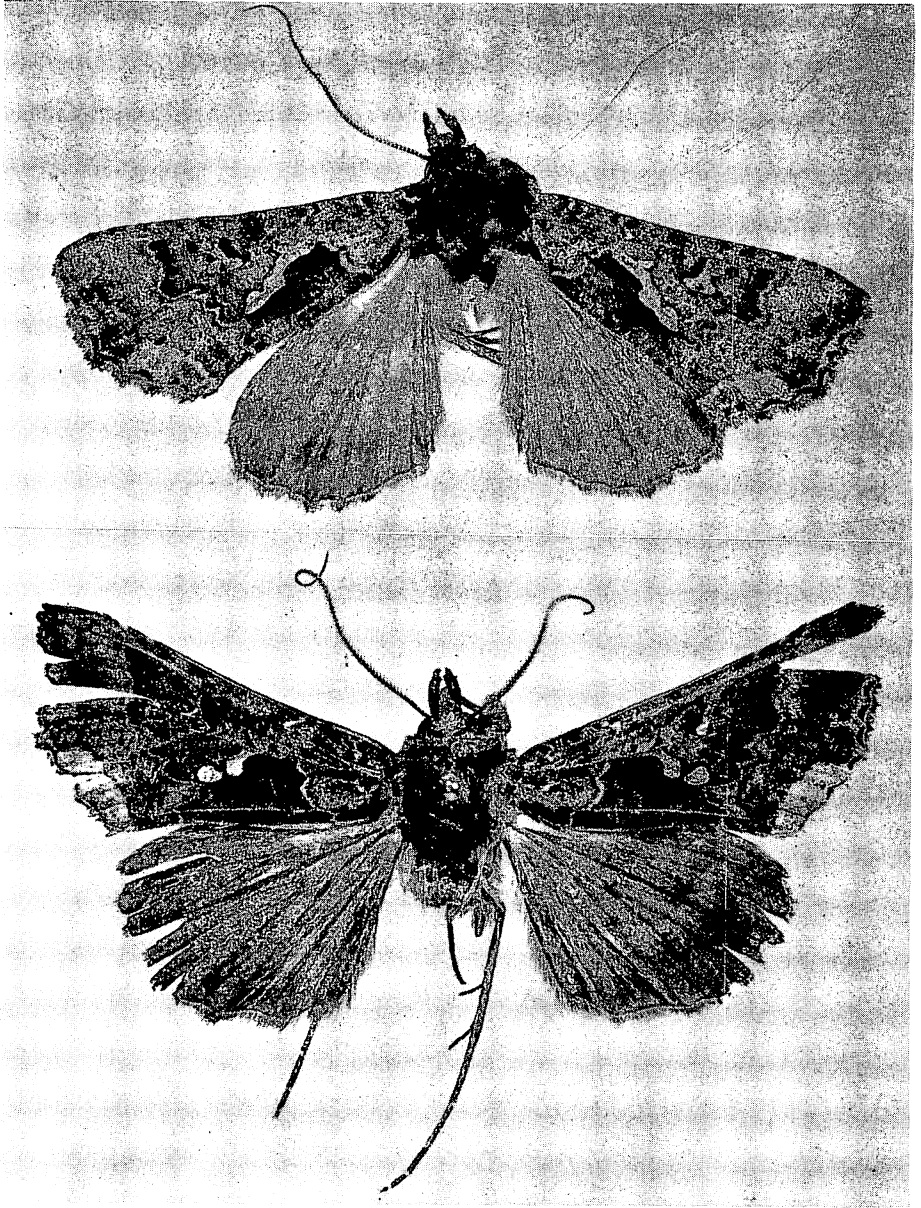


Figure 301—*Plusia (Lophoplusia) giffardi* (Swezey), female type; Kilauea, Hawaii; expanse, 38 mm. (above). Below: *psectrocera* (Hampson), type female; Kaupo Trail, Maui; 7,000 feet; expanse, 40 mm.

Some authors have split *Plusia* into a number of genera, but a more conservative course will be followed here. McDunnough (1944) revised the North American species and divided them into a number of genera, principally according to characters of the genitalia. Forbes (1954) considers most of McDunnough's generic groups as subgenera. Until the subfamily can be revised on a worldwide basis, it appears better to consider the groups of species found in Hawaii as subgenera, and this course will place emphasis on their similarities and group characteristics.

Subgenus **LOPHOPLUSIA**, new subgenus

*Phytometra* Sections I and II, Hampson, 1913:452, 453.

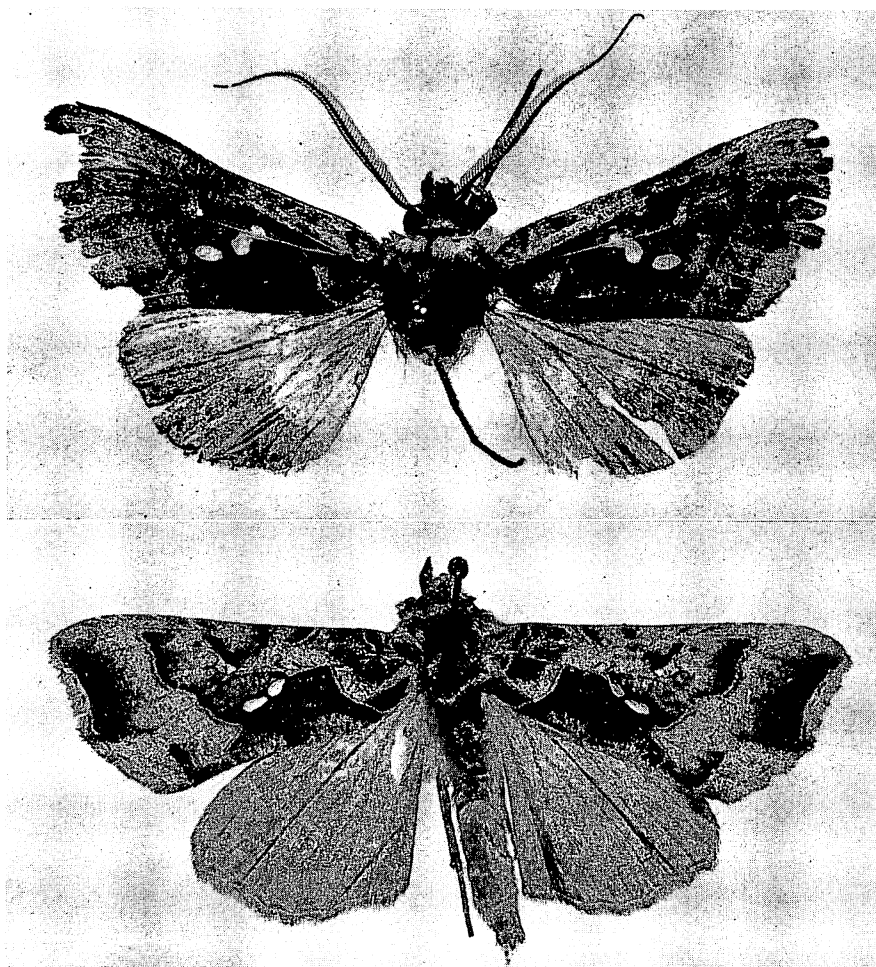


Figure 302—*Plusia (Lophoplusia) pterygota* (Meyrick), male type, southeastern Koolau Mts.; expanse, 37 mm. (above). Below: *violacea* (Swezey), type female; Kokee, Kauai; expanse, 38 mm.

The endemic Hawaiian species all have the antennae conspicuously bipectinate in both sexes. This is a feature unique in the entire group, and we may use this character to define the new subgenus.

Type: *Plusia pterygota* Meyrick. Gender of *Lophoplusia*: feminine.

This is a closely knit group of endemic moths. Unfortunately, only a few ex-

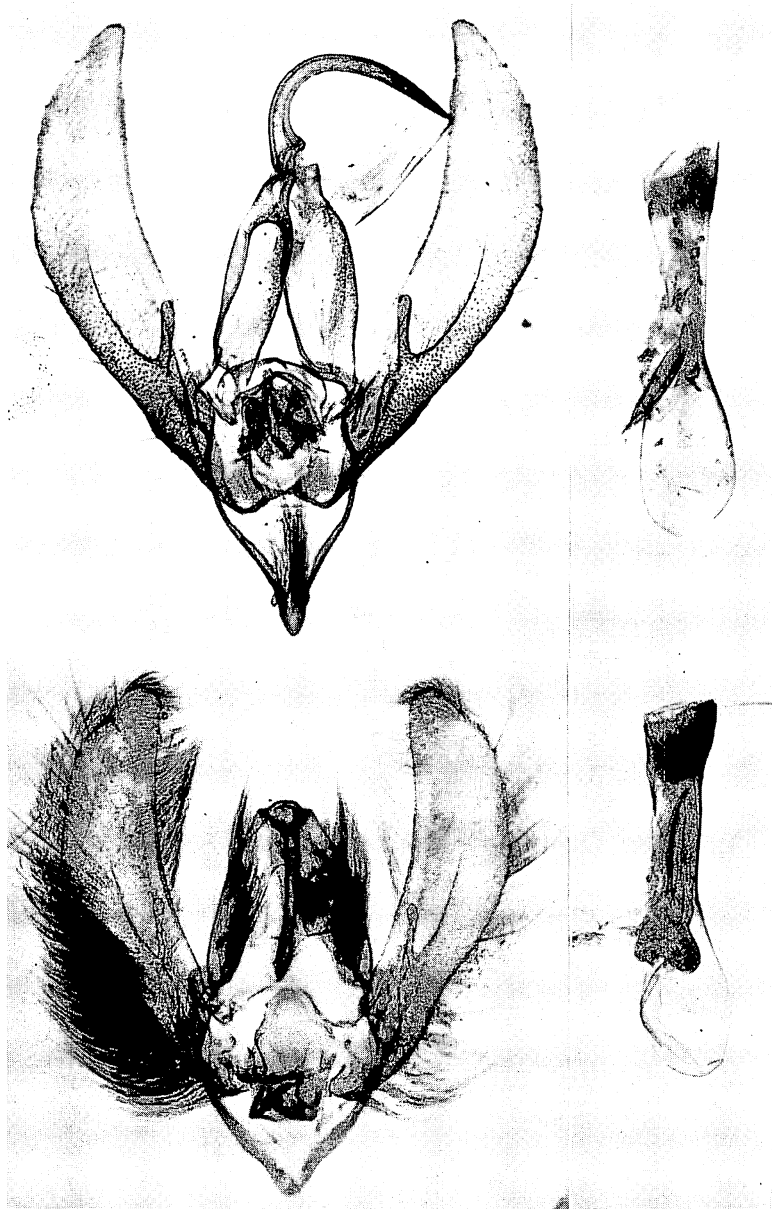


Figure 303—Male genitalia of *Plusia* (*Lophoplusia*). Above: *giffardi* (Swezey). Below: *pterygota* (Meyrick), the type; southeastern Koolau Mts., Oahu.





Figure 304—Female genitalia of *Plusia* (*Lophoplusia*). Above: *giffardi* (Swezey). The bursa extends out of the photograph at the left bottom; the enlargement is part of the spermatophore, not the signum. Below: *psectocera* (Hampson), type from Maui; the abdomen was decomposed. Spermatophore at right.

amples of the species have been collected, and the limits of specific variability are unknown. Perkins noted their rarity, which he could not explain.

KEY TO THE SPECIES OF LOPHOPLUSIA

- 1. Postmedial line of fore wing at most only slightly concave at the fold, not deeply notched there, the entire line comparatively straight and the irregularities comparatively shallow, as illustrated; with extensive orange coloring; Oahu.....**pterylota** (Meyrick).  
Postmedial line of fore wing strongly irregular, deeply notched at fold, as illustrated.....2
- 2(1). Fore wing without a longitudinal streak or bar of metallic scales at base just behind medial vein, considerably suffused with pale violet, postmedial line gently waved anterior to notch on fold.....**violacea** (Swezey).  
Fore wing with a longitudinal streak or bar of metallic scales just below medial vein extending from near base to near antemedial line, postmedial line moderately or strongly zigzag above fold.....3

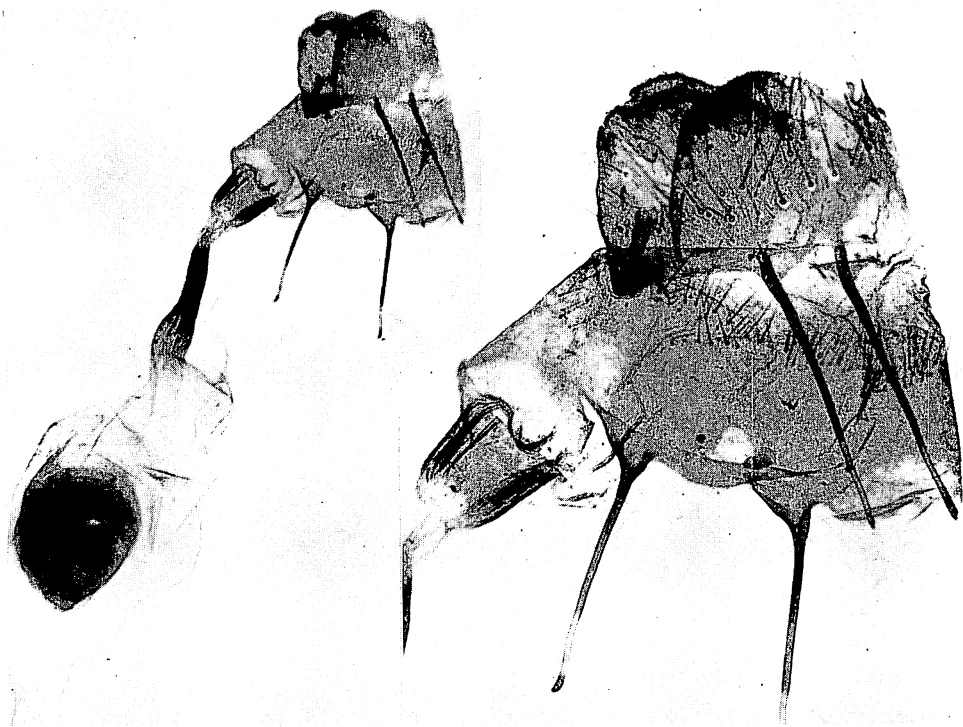


Figure 305—Female genitalia of *Plusia* (*Lophoplusia*) *violacea* (Swezey), type; Kokee, Kauai. Bursa extends below photograph; the dark mass is part of a spermatophore.

3(2). Hind wings very dark, approaching black; fore wings with terminal pale area posterior ("dorsad") of vein three and outward from subterminal line with extensive metallic scaling, without extensive reddish scaling; Maui. . . . . **psectrocera** (Hampson).

Hind wings paler than *psectrocera*, pale brownish basad; fore wings with extensive reddish scaling; the pale terminal area distad of subterminal line and posterior to vein three with extensive violet or reddish scaling and not conspicuously metallic, but some metallic scaling *basad* of subterminal line; Hawaii. . . . .  
 . . . . . **giffardi** (Swezey).

**Plusia (Lophoplusia) giffardi** (Swezey), new combination (figs. 301, 303, 304).

*Plusia giffardi* Swezey, 1913:270.

*Phytometra giffardi* (Swezey) Swezey, 1920:336.

Endemic. Molokai, Maui, Hawaii (type locality: Kilauea).

Hostplant: Unknown.

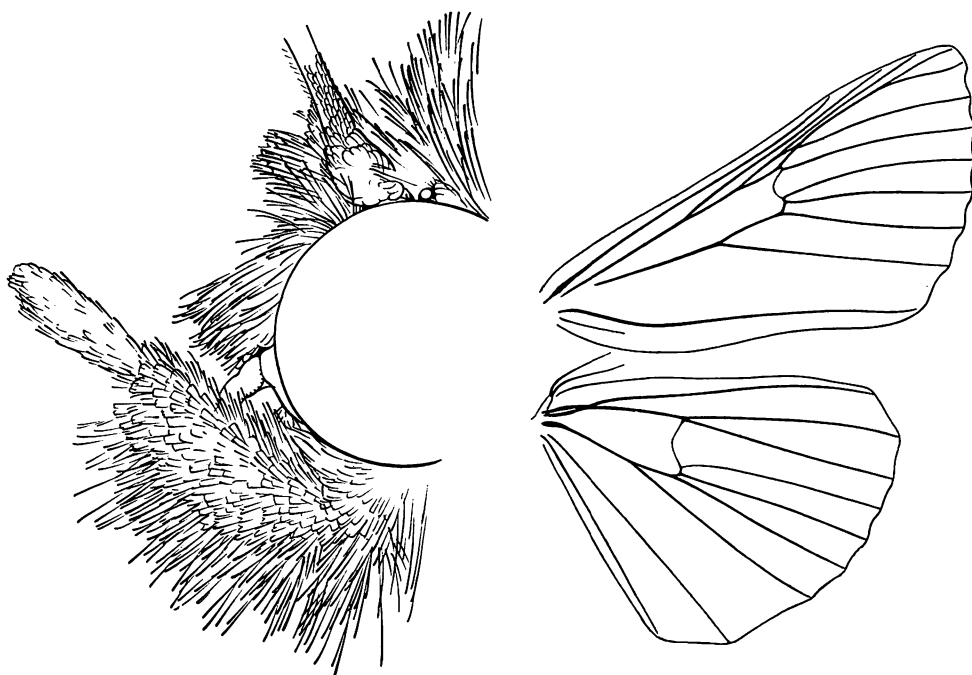


Figure 306—Head (left) and wing venation (right) of *Plusia (Trichoplusia) ni brassicae* (Riley).

**Plusia (Lophoplusia) psectrocera** (Hampson), **new combination** (figs. 300, 301, 304).

*Phytometra psectrocera* Hampson, 1913:453, fig. 116.

Endemic. Maui (type locality: Kaupo Trail, 7,000 feet).

Hostplant: Unknown.

This species was sunk as a synonym of *giffardi* by Swezey (1920:336), but I have examined the holotype in the British Museum, and I do not consider the species to be the same.

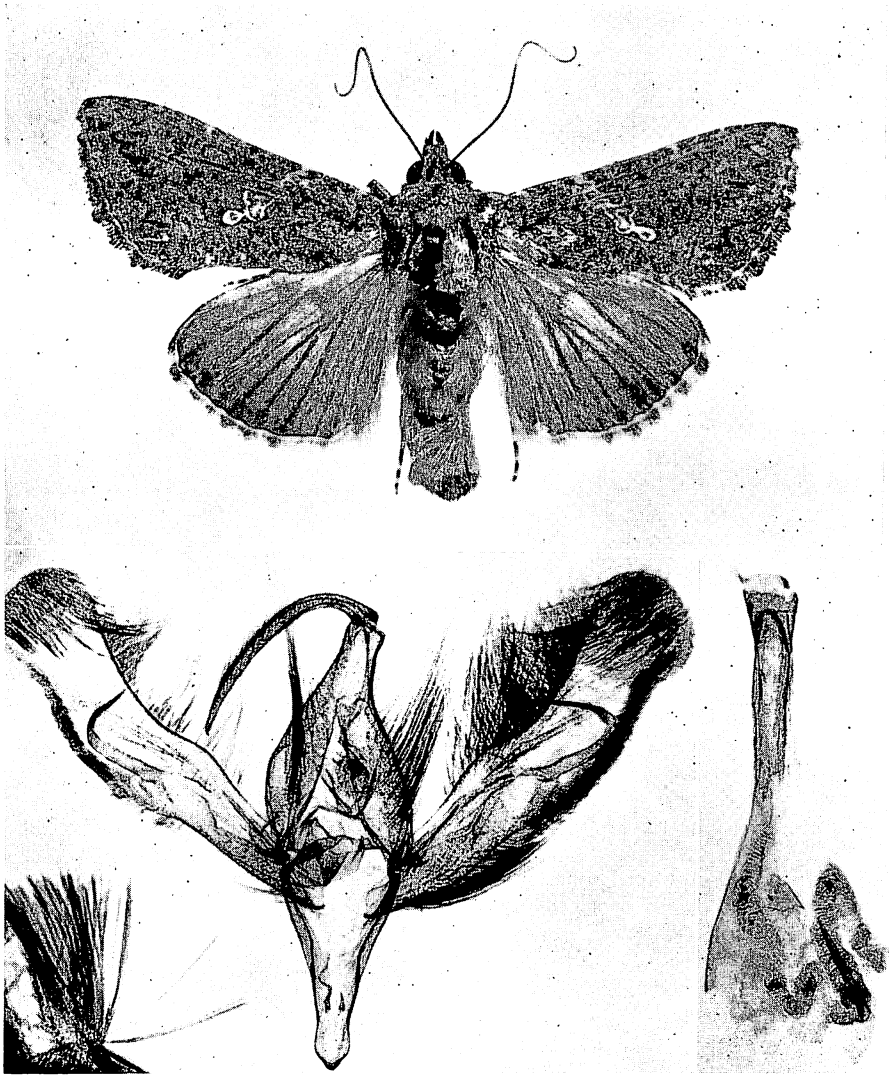


Figure 307—*Plusia (Trichoplusia) ni brassicae* (Riley); Honolulu; reared from broccoli; expanse, 37 mm. Below: Male genitalia of an example from Glendale, California.

Hampson said that the holotype was a male, but it is a female. He stated that the type locality was "Campo Trail," but that is in error for Kaupo Trail. His figure of the type is artificial, because the specimen is in a frayed, torn condition; it is not as is indicated in the illustration, which is an artist's reconstruction.

**Plusia (Lophoplusia) pterygota** (Meyrick), **new combination**, type of *Lophoplusia* (figs. 299, 300, 302, 303).

*Plusia pterygota* Meyrick, 1904:348.

*Phytometra pterygota* (Meyrick) Hampson, 1913:452, fig. 115.

*Plusia newelli* Perkins, manuscript name, Swezey, 1920:336.

Endemic. Oahu (type locality: Mt. Tantalus), Maui, Hawaii.

Hostplant: Hollyhock (this is not the natural hostplant, however).

The type locality cited by Meyrick is "S.E. Koolau range," and Dr. Perkins has said that the type was taken on Mt. Tantalus. Hampson erroneously listed the type locality as "Hawaii, S.S. Korlan Range" (see Swezey, 1920:336).

**Plusia (Lophoplusia) violacea** (Swezey), **new combination** (figs. 302, 305).

*Phytometra violacea* Swezey, 1920:337.

*Plusia violacea* (Swezey) Swezey, 1929:274.

Endemic. Kauai (type locality: Kokee).

Hostplant: Unknown.

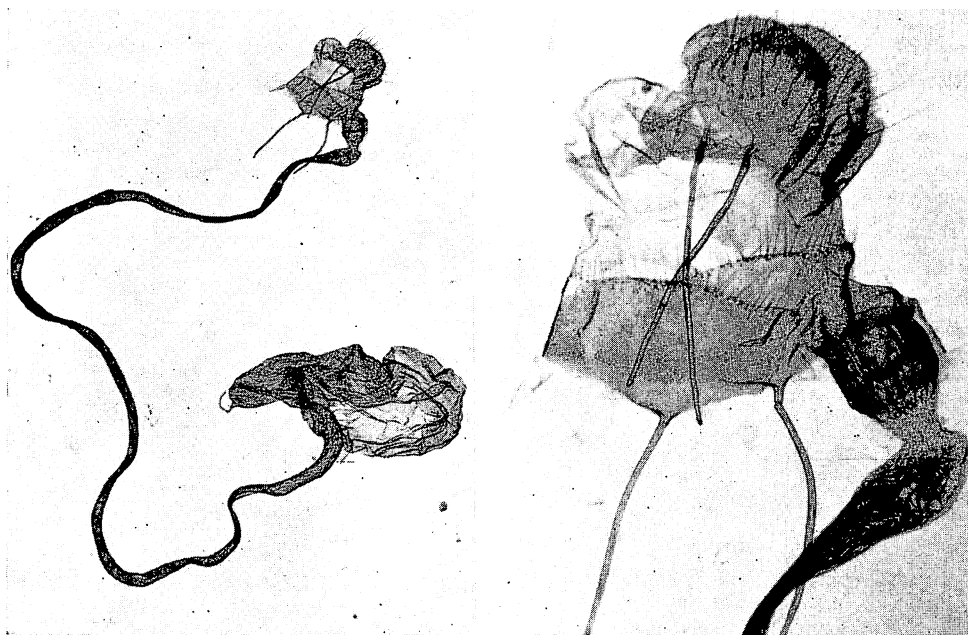


Figure 308—Female genitalia of *Plusia (Trichoplusia) ni brassicae* (Riley) from California.

Subgenus **TRICHOPLUSIA** (McDunnough) Forbes, 1954:302

Genus *Trichoplusia* McDunnough, 1944:204.

**Plusia (Trichoplusia) ni brassicae** (Riley), type of *Trichoplusia* (figs. 306, 307, 308).

*Plusia brassicae* Riley, 1870:110. Chittenden, 1902:60–69, fig. 13.

*Phytometra brassicae*, of authors. Hampson, 1913:467, pl. 237, fig. 10.

*Autographa brassicae*, of authors.

*Trichoplusia ni brassicae* (Riley) McDunnough, 1944:204, pl. II, fig. 3, pl. V, fig. 6.

Crumb, 1956:253, 254, larva.

The cabbage looper.

Kauai, Oahu, Molokai, Maui, Hawaii.

Immigrant; a widespread garden pest. First recorded from Hawaii in 1940 by E. Lucas from specimens captured on Molokai in 1939.

Hostplants: Broccoli, cabbage, cauliflower, lettuce.

The caterpillar has prolegs on abdominal segments five and six, none on three and four, a longitudinal white line above spiracles which occupies "only one-third to one-half of the space between the spiracles and setae III. About 25 to 30 mm. in length." (Swezey, 1944:142.) For illustrations of larva, see Peterson, 1948:188, figs. L 39, D-G.

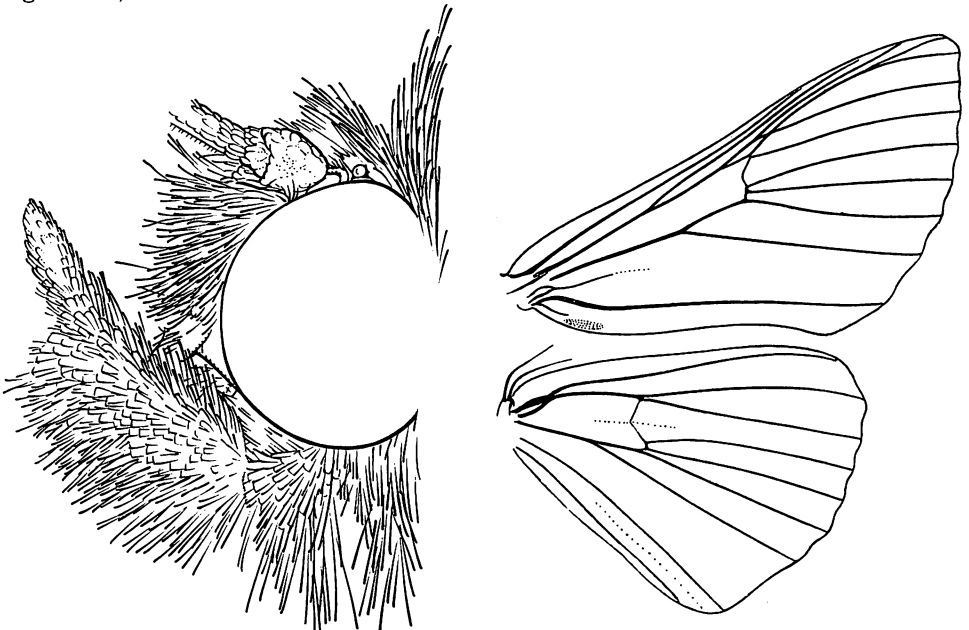


Figure 309—Head (left) and wing venation (right) of *Plusia (Autographa) chalcites* (Esper).

Subgenus **AUTOGRAPHA** (Huebner)

*Autographa* Huebner, 1821:251. Type: *Phalaena* (*Noctua*) *gamma* Linnaeus, see Grote, 1895:417 (not *Noctua parilis* Huebner, as cited by Hampson, 1913:404).

## KEY TO THE SPECIES OF AUTOGRAPHA FOUND IN HAWAII

1. Metallic mark in fore wing entire, deeply indented on costal side, but not divided, roughly 8-shaped; antemedial line in fore wing distinctly bowed distad in nearly a shallow C-shaped manner half way between the posterior margin of the wing and the cell (or yoke-shaped). . **biloba** (Stephens).
2. Metallic mark in fore wing divided into two separate spots; antemedial line in fore wing nearly straight from posterior margin of wing to beyond half way to the cell, the entire line only slightly arcuate or sinuous. . . . . **chalcites** (Esper).

**Plusia** (**Autographa**) **biloba** (Stephens) (figs. 298, 310, 311, 312).

*Plusia biloba* Stephens, 1829:104.

*Phytometra biloba* (Stephens) Hampson, 1913:512, pl. 238, fig. 5.

*Autographa biloba* (Stephens), of authors.

Crumb, 1956:257, larva.

Kauai, Oahu, Maui, Lanai, Hawaii.

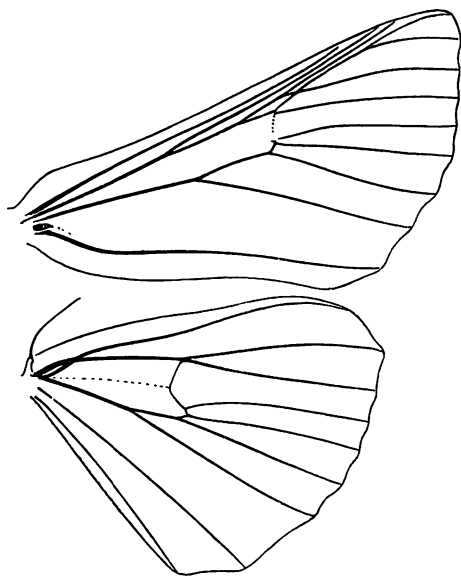


Figure 310—Wing venation of *Plusia* (*Autographa*) *biloba* (Stephens).

Immigrant. Widespread in America. First reported from Hawaii by Meyrick in 1899, when it was widespread in the Islands.

This species appears to be rather uncommon in Hawaii, and we do not know much about its habits here. Forbes (1954:304) says, "occasionally injurious to garden crops on Long Island." It resembles closely *hopalosema* (Hampson) and *confusa* (Stephens), which are found in Japan and the Orient and might be inter-

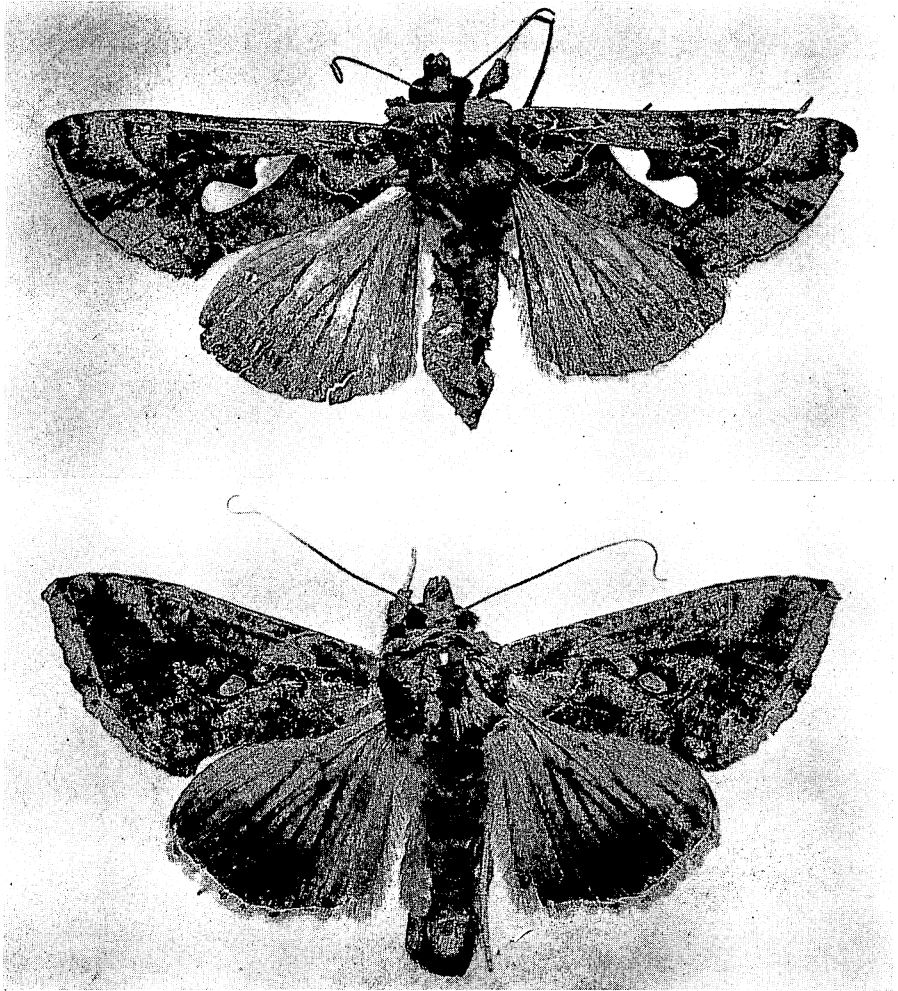


Figure 311—Above: *Plusia (Autographa) biloba* (Stephens), female; Olaa, 29 Miles, Hawaii; 3,800 feet; expanse, 39 mm.; compared with the type. Below: *chalcites* (Esper), male; Kaimuki, Oahu; expanse, 40 mm.



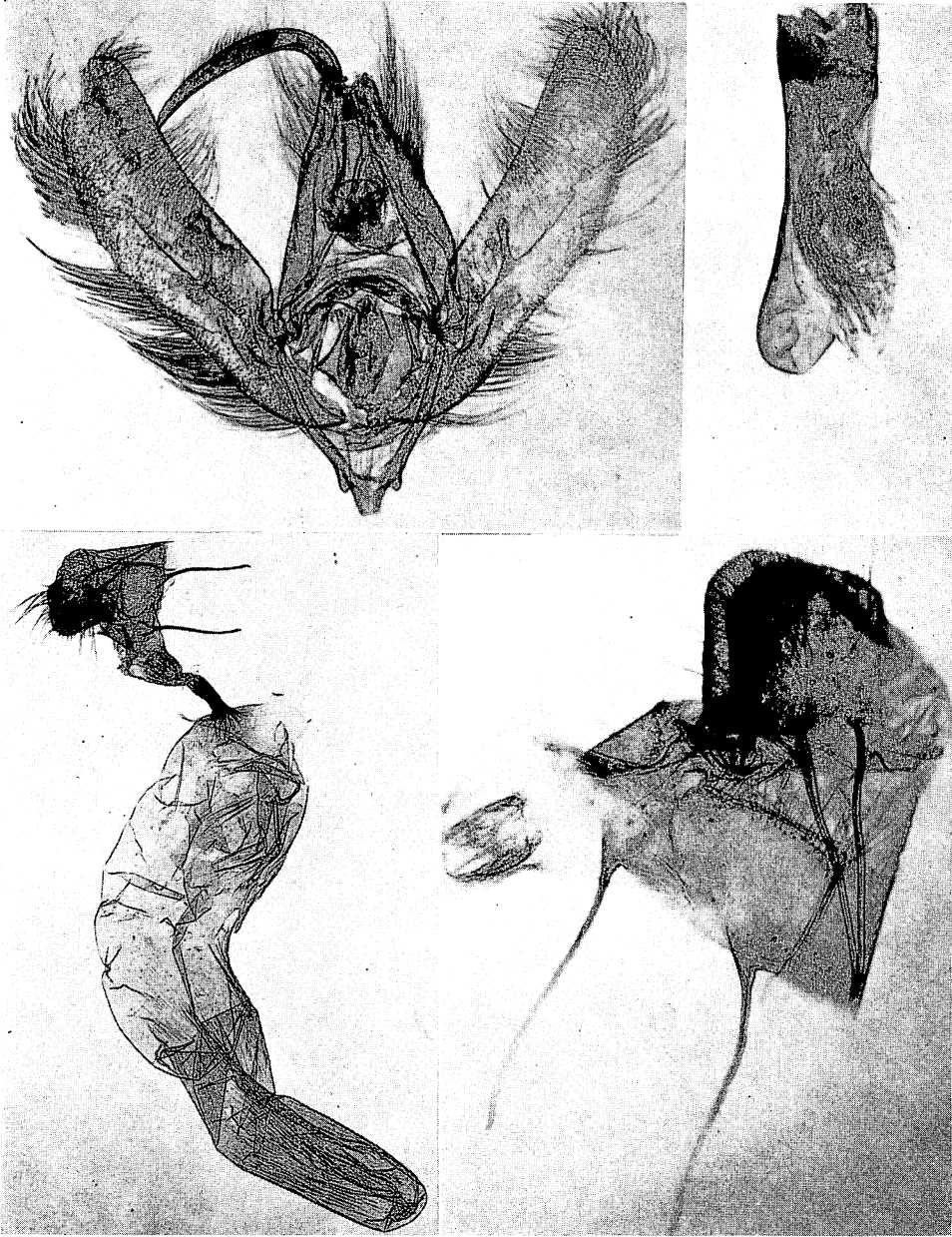


Figure 312—*Plusia (Autographa) biloba* (Stephens). Male genitalia (above) from a specimen from Kona, Hawaii; female genitalia (below) from a specimen from southern California.

cepted in quarantine or introduced. This species, however, has the antemedial line on the fore wing yoke-shaped, whereas it is nearly straight or only slightly arcuate on the other two species. This same character is useful in separating *biloba* and *chalcites*.

***Plusia (Autographa) chalcites* (Esper) (figs. 309, 311, 313, 314).**

*Phalaena-Noctua chalcites* Esper, 1789:447, pl. 141, fig. 3.

*Plusia verticillata* Guenée?, Butler, 1877:47; 1878:185; 1880:8.

*Plusia chalcites* (Esper), of authors.

*Phytometra chalcites* (Esper) Hampson, 1913:484, fig. 122.

The garden looper.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii, Midway, Kure (Ocean).

Immigrant. A widespread Old World species; widespread in many islands in the Pacific. First reported from Hawaii by Butler (1877:47).

Hostplants: *Adenostemma viscosum*, *Ageratum conyzoides*, basil, bean, beet, cabbage, canna, celery, Chinese pea, *Coleus*, corn, cotton, *Datura*, eggplant, *Emilia*, *Epidendrum*, *Euxolus*, *Ipomoea*, *Lantana*, lettuce, lima bean, mint, *Panicum torridum*, parsley, *Pelargonium*, *Phaius*, *Pipturus*, potato, *Salvia*, *Setaria verticillata*, *Sida*, *Sonchus*, *Spathoglottis*, spinach, sunflower, sweetpotato, tomato, wild yam, *Verbesina*, *Viola*, *Xanthium* (cockle burr).

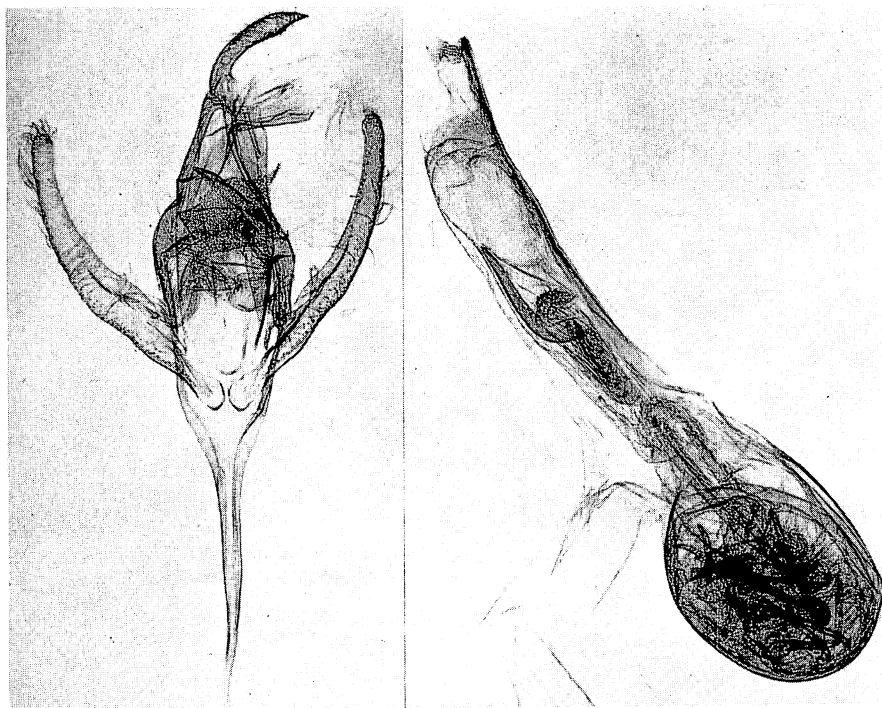


Figure 313—Male genitalia of *Plusia (Autographa) chalcites* (Esper), from Oahu.

Parasites: *Chaetogaedia monticola* (Bigot), *Copidosoma truncatellum* (Dalman) (= *Litomastix floridanum* (Ashmead)); as high as 85% parasitism, *Eucelatoria armigera* (Coquillett), *Hyposoter exiguae* (Viereck), a bacterial wilt disease, a fungus on both larvae and adults.

The following notes on the life history are abstracted from Swezey (1906: 53-55):

Eggs white, deposited singly on under surfaces of leaves, about 0.5 mm. in diameter, flattened, height about one-half diameter; entire surface covered with concavities similar to those on a thimble and arranged in regular rows radiating from apex. Incubation period about six days.

First stage larvae about 2 mm. long, green with black hairs situated in small, black tubercles. The young larvae eat only one side of the leaf, leaving the opposite epidermis, but when five days old they eat holes through the leaf, and the older caterpillars feed from the margin of the leaf, also. There is little change in the larvae in the various instars. Full-grown caterpillars are about 36 mm. long, bright green, with a white line just above the line of the spiracles, and several faint, crinkly, white lines down the back; there is often a black spiracular line; tubercles mostly white, except a row of larger black ones just above the spiracles (tubercles usually all black prior to the last molt). Feet often black. Head green

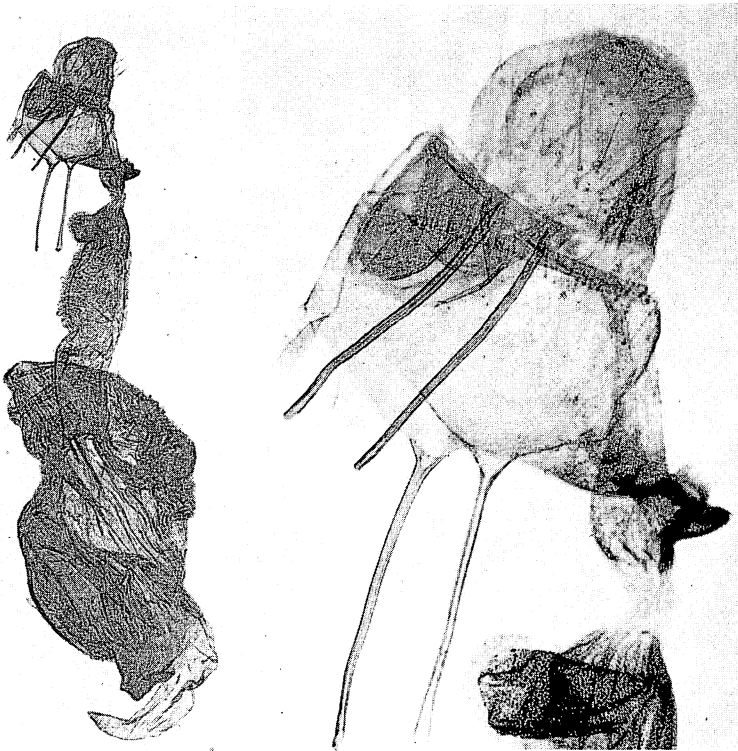


Figure 314—Female genitalia of *Plusia* (*Autographa*) *chalcites* (Esper); from an Hawaiian specimen collected by Blackburn.

with black dots at bases of hairs, a black line on lateral margins; mandibles blackish at tips and edges. Prolegs on segments 9, 10 and 13. When at rest the caterpillar has its back humped up, and when it crawls it does so in a looping motion (somewhat similar to the Geometridae, but this caterpillar has an additional pair of abdominal prolegs). The larval period is about three weeks.

Pupa pale green with a broad, brown streak on the back; darker on the margins of the segments; the pupa turns brown a short while before the imago is ready to emerge; wing- and leg-cases extend slightly beyond the posterior margin of the fourth abdominal segment; cremaster short, with several small brown hooks attaching the pupa to the slight, white, silken cocoon which is made between fastened-together leaves or a fold in a leaf; pupal period 8 to 11 days.

This species on occasion does considerable damage to such plants as lettuce, potato, orchids, and it is listed as a "sub-major" pest of garden beans by Holdaway and Look (1942:255).

#### Subfamily HYPOCALINAE

*Erebida* Leach, 1815:134. (Name unavailable for this group; see Prout, 1921:2.)

*Homopterides* Boisduval, 1833:108, in part.

*Hypocalidae* Guenée, 1852:73.

*Ophideridae* Guenée, 1852:108.

*Erebidae* Guenée, 1852:127.

*Polydesmidae* Guenée, 1852:436.

*Ophiderinae* Prout, 1921:2.

*Erebinae* Forbes, 1954:356.

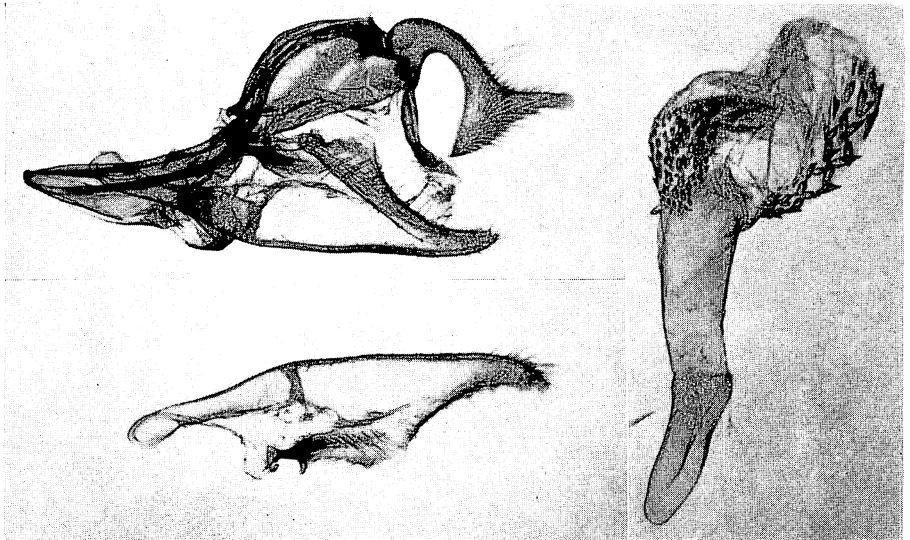


Figure 315—*Otosema odora* (Linnaeus). Lateral view of male genitalia (upper left), left valve (lower left); and aedeagus with internal sac extruded (right). A British Guiana specimen.

Genus **OTOSEMA** Huebner, 1823

**Otosema odora** (Linnaeus) (figs. 315, 316, 317, 318).

*Phalaena Bombyx odorata* Linnaeus, 1758:505.

*Phalaena Bombyx odora* Linnaeus, 1764:374, emendation.

*Erebus agarista* Cramer, 1779:112, pl. 170, figs. A, B.

*Erebus marquesi* Paulsen, in Philippi, 1871:290, fig. 5.

*Erebus odora* (Linnaeus), of authors.

The black witch moth.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant; a South American species. First reported in Hawaiian literature in 1929 by Bryan from specimens taken on Oahu and Hawaii in 1928, but known to have been established on Hawaii prior to that date.

Hostplants: *Cassia nodosa*, *Samanea saman* (monkey pod, the common host).

Parasites: I have been unable to find any records of parasites of this species in Hawaii. This is an unusual situation.

Predators: Cardinals, mynah birds, English sparrows.

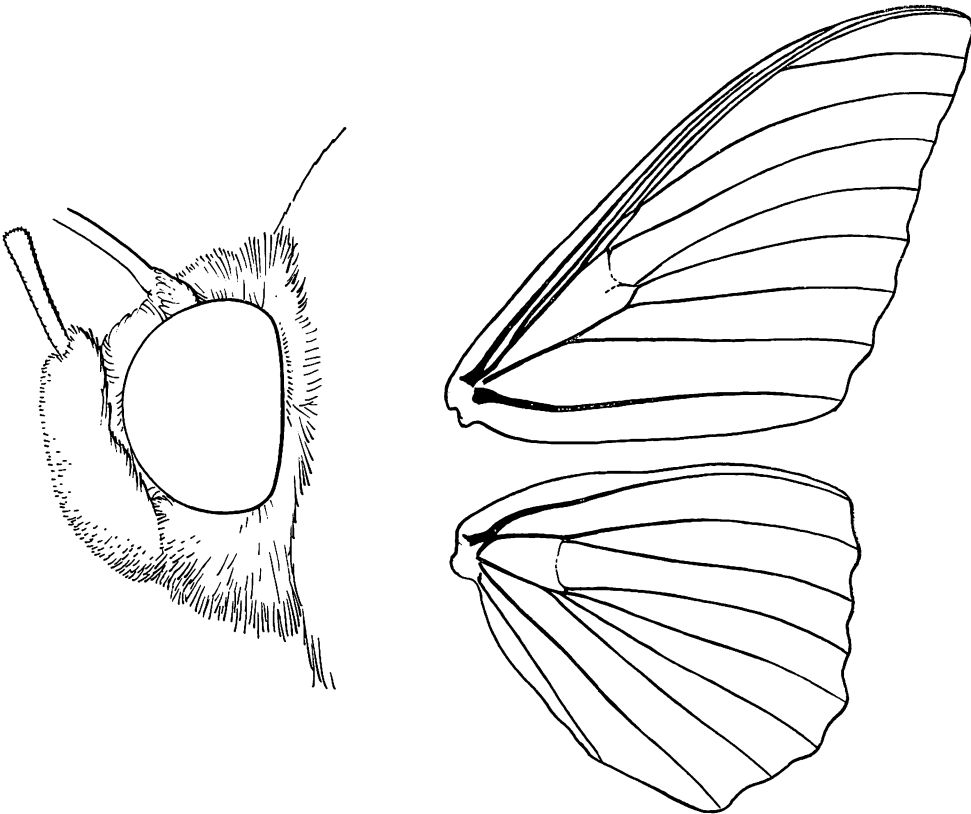


Figure 316—Head (left) and wing venation (right) of *Otosema odora* (Linnaeus).

This is the largest lepidopteron in Hawaii, and the wing expanse is over 100 mm., or more than four inches. The spherical eggs, which have numerous, fine meridional ridges, are deposited singly on the hostplant. As many as 400 eggs may be deposited by one female. The eggs hatch in about nine days, the larval period is from 19 to 41 days, and the pupal period from 20 to 23 days, according to

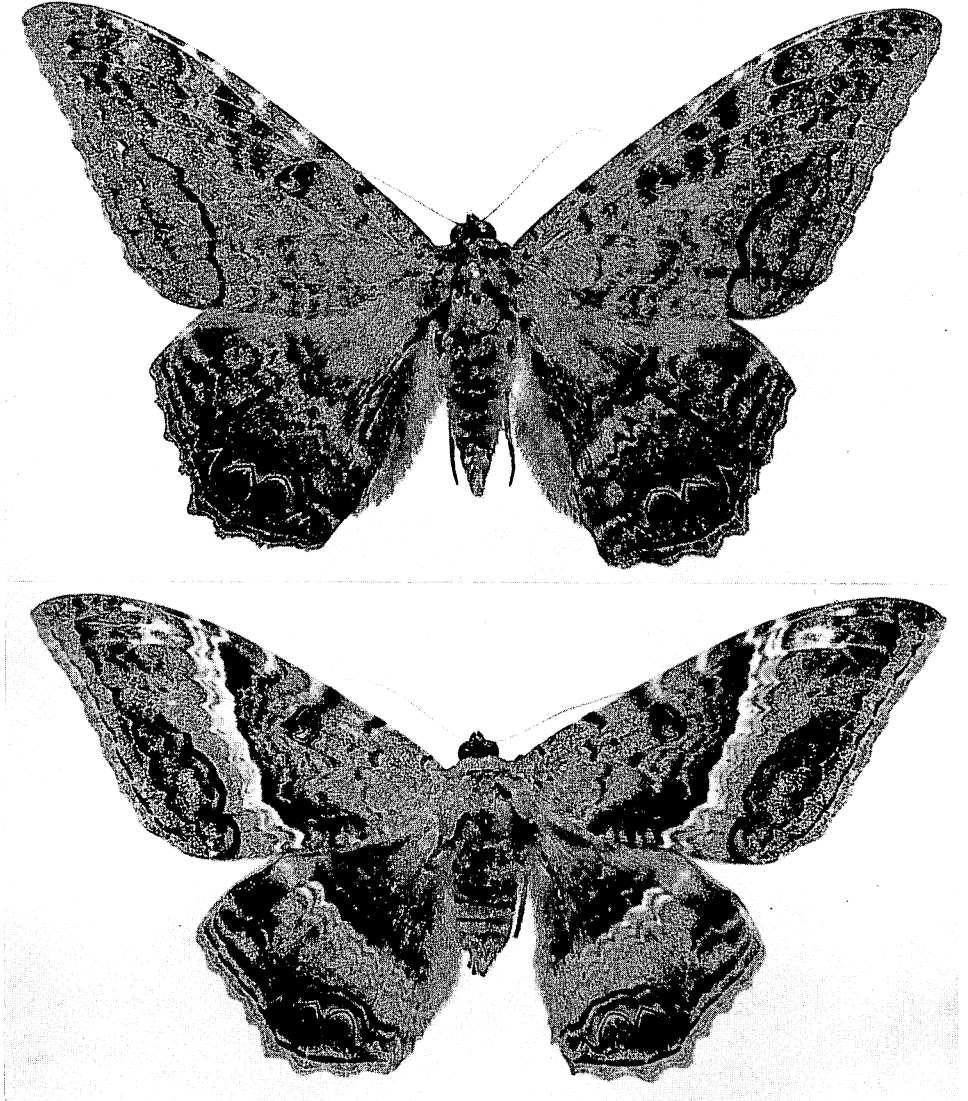


Figure 317—*Otosema odora* (Linnaeus). Above: Male; Honolulu; expanse, 128 mm. Below: female; Niu, Oahu; expanse, 144 mm.

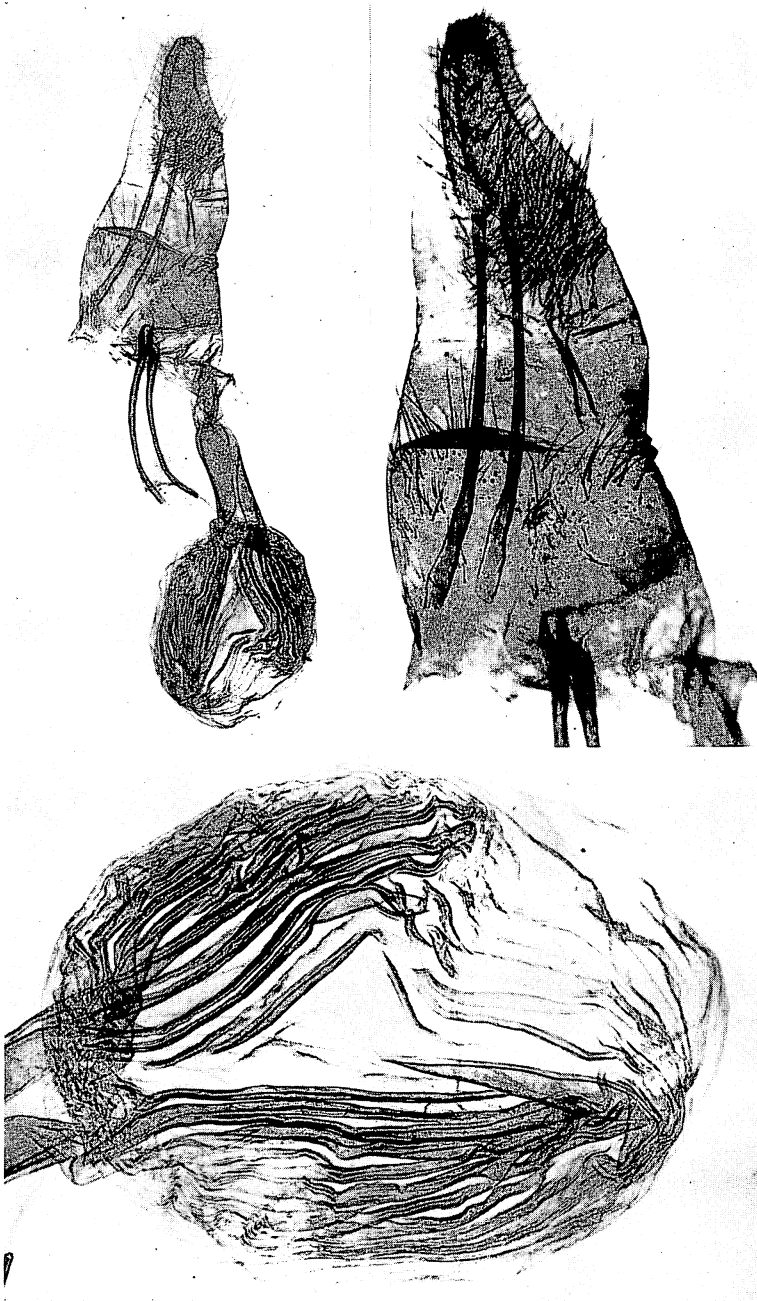


Figure 318—Female genitalia of *Otosema odora* (Linnaeus).

experiments carried on by Dr. Swezey. The full-grown larva may be 70 mm. in length. The caterpillars feed on the foliage at night and hide in cracks and crevices and under bark during the day. The first-stage larvae have prolegs on abdominal segments five and six; second-stage caterpillars have prolegs on abdominal segments three, four, five and six, but those on the third segment are small and not functional; after the second molt, all four pairs of prolegs are fully developed. The cocoon is a loose silken structure. The adult female is paler in color than the dark male.

The moths were attracted to fermenting bananas which I used to trap *Drosophila*.

Genus **GONITIS** Guenée, 1852:403

*Tiridata* Walker, 1865:810 (type *sabulifera* Guenée = *colligata* Walker).

See the notes under *anomis*, below, for discussion of genera.

**Gonitis vulpicolor** (Meyrick), **new combination** (figs. 319, 320, 321, 322).

*Cosmophila vulpicolor* Meyrick, 1928:94.

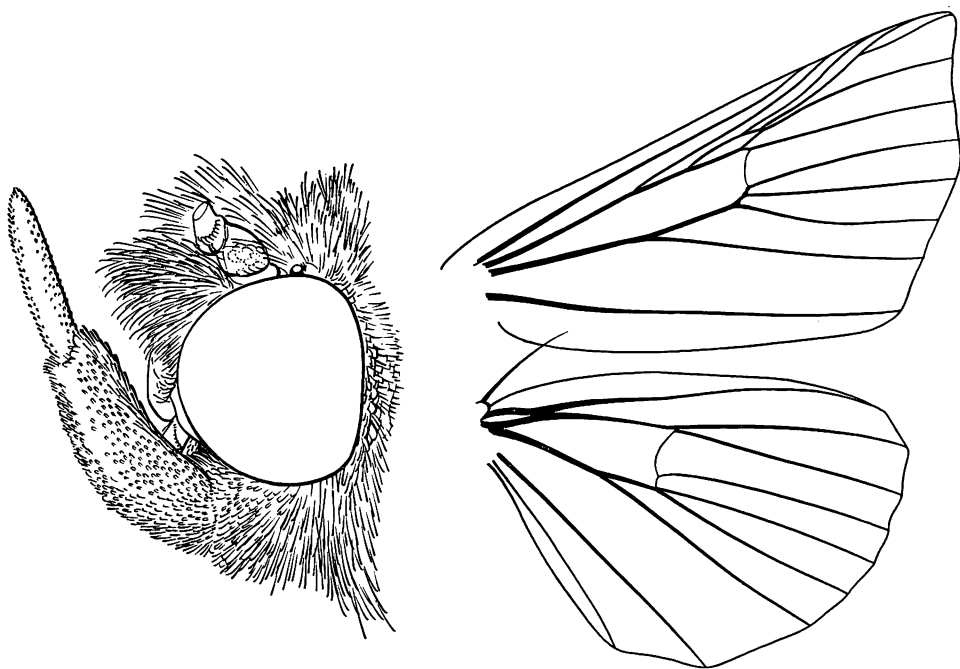


Figure 319—Head (left) and wing venation (right) of *Gonitis vulpicolor* (Meyrick).



Endemic. Oahu (type locality: upper Manoa Valley, Honolulu), Molokai, Hawaii.

Hostplant: *Osteomeles anthyllidifolia*.

The caterpillar has four pairs of abdominal prolegs, whereas our two other species which were heretofore placed with this species and assigned to *Cosmophila* have only three pairs of abdominal prolegs. This fact led me to a detailed study of our species assigned to *Cosmophila*, and I have found that two genera are involved. This species fits nicely into *Gonitis* and must be transferred. Further discussion is given under the following genus.

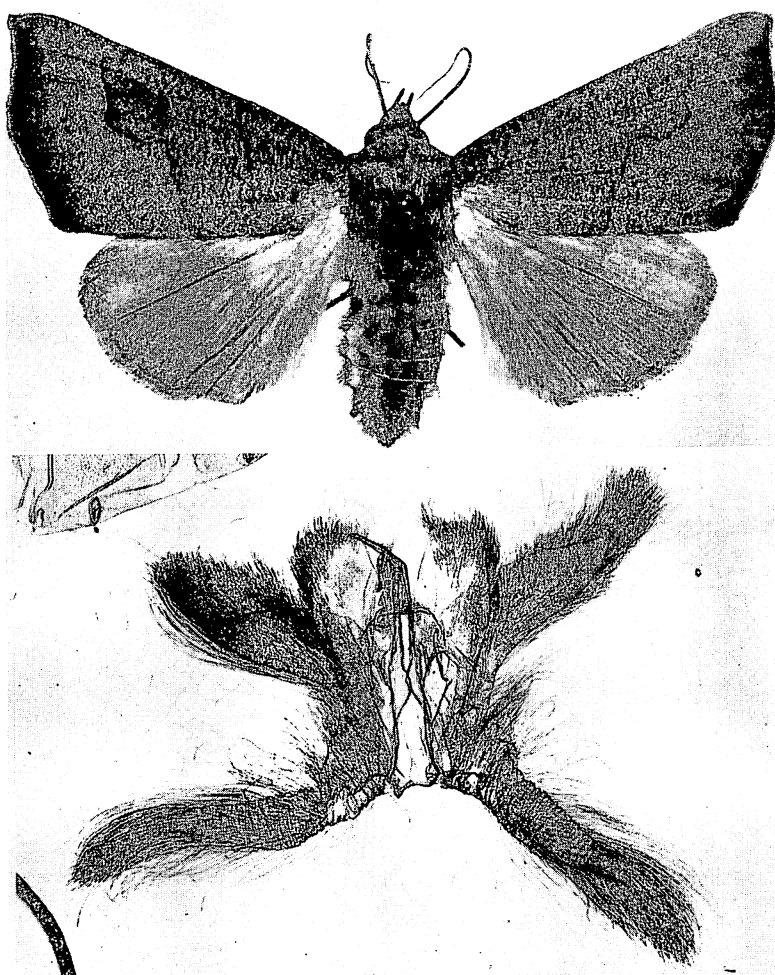


Figure 320—*Gonitis vulpicolor* (Meyrick); Niu, Oahu; reared from *Osteomeles*; expanse, 44 mm.; compared with the type, which it closely resembles. Below: Male genitalia, aedeagus removed, from a paratype from Honolulu; the lower appendages are very soft sacs.

Genus **ANOMIS** Huebner, 1822

*Anomis* Huebner, 1822 (1821):198; type *exacta* Huebner, 1822:198.

Hampson's synonymy under *Anomis* (1926:345) is a muddle, and it all must be checked carefully.

The two species assigned to *Anomis* here have for many years appeared under *Cosmophila* in Hawaiian literature. *Cosmophila* Boisduval, 1833 (type *xanthyn-dima* Boisduval), is a genus quite distinct from *Anomis*, and our species cannot remain in *Cosmophila*. The genus *Gonitis* also is involved in this complex, as may be noted as follows:

*Gonitis* Guenée, 1832:403, originally included two species: *editrix* Guenée from Haiti, and *sabulifera* Guenée from Abyssinia. No citation of type was made, although Guenée assigned *sabulifera* to *Gonitis* with some hesitation because his specimen was imperfect. Hampson (1926:345) definitely cited a type species, and he selected *editrix*. I at first thought that *editrix* and *sabulifera* might be varieties of one species, but a study of the genitalia has shown them to be distinct but allied species. This poses a question: Has *editrix* been introduced to South America, or does it represent natural, transocean colonization? *Gonitis sabulifera* is a

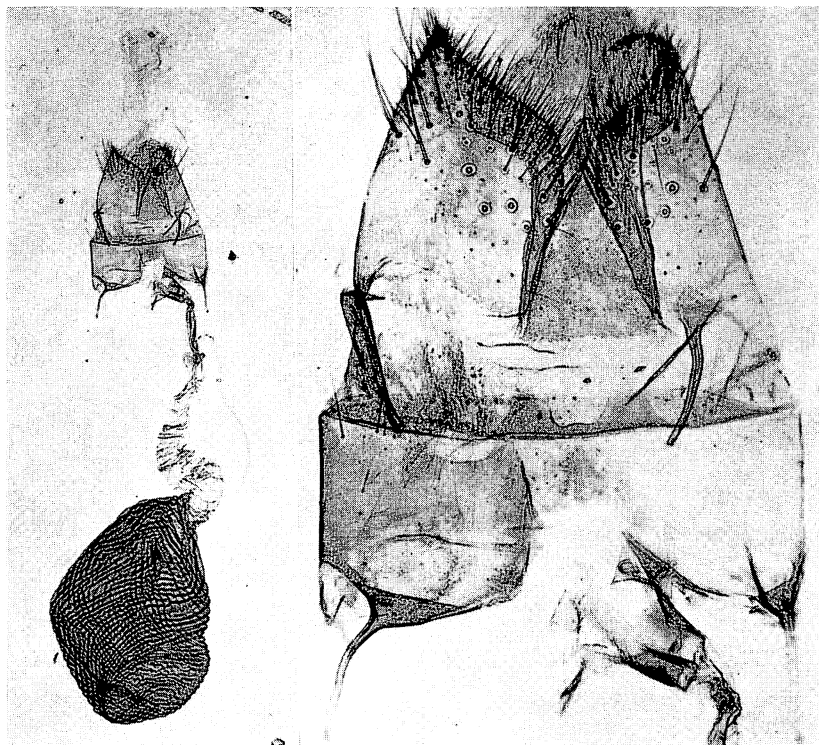


Figure 321—Female genitalia of a paratype of *Gonitis vulpicolor* (Meyrick), Honolulu.

widely distributed moth from Africa through the Near East, Malaysia, Australia and out through the Pacific Islands to the Marquesas Islands. *Gonitis* is a good genus, and our *Cosmophila vulpicolor* Meyrick, must be transferred to it, as has been done above. The genus *Tiridata* Walker, 1865, has the same type as *Gonitis*, and it is thus a synonym. The larva of *Gonitis sabulifera* has four pairs of abdominal prolegs, as does our *vulpicolor*.

On the other hand, the other two species which have been placed in *Cosmophila* in our literature are not congeneric with *Gonitis*, and they must be placed in *Anomis*. One of these, described as *Gonitis hawaiiensis* by Butler, has been placed as a synonym of *Gonitis* ("Cosmophila") *sabulifera* Guenée by Meyrick (1899: 158) and it appears in our collections and literature as *Cosmophila sabulifera* (Guenée). This synonymy is quite wrong. I cannot understand what led Meyrick to synonymize the species, because *sabulifera* has erect hair on the head, but the

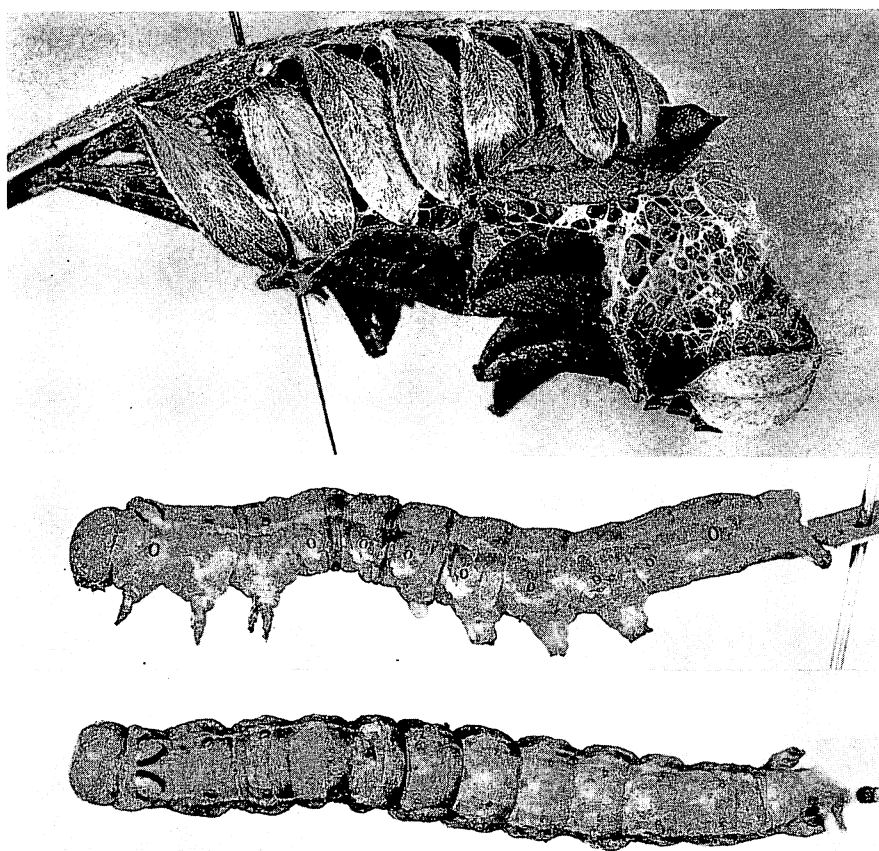


Figure 322—*Gonitis vulpicolor* (Meyrick). Above: *Osteomeles* leaflets webbed together to form a "nest"; length, 33 mm.; Manoa, Honolulu. Below: Two views of an inflated larva, 32 mm. long; from Kalae, Molokai.

head of *hawaiiensis* is clothed with broad, shingle-like scales, to mention only a very conspicuous difference. It must be admitted, however, that superficially the species have rather similar facies. The other species, *noctivolans*, was described by Butler as a *Toxocampa*. These two species—*noctivolans* and *hawaiiensis*—are closely allied. Superficially, they appear more like *Gonitis sabulifera* than does *vulpicolor*, but they are generically distinct. The larvae of these two species have only three pairs of abdominal prolegs, instead of the four pairs as on *Gonitis*. The moths of both species of *Anomis* in Hawaii are highly variable in color pattern.

The male genitalia of these species are kept largely retracted in the abdomen. They are mostly soft and pliable, and from the bases of the valves there arise narrow, soft, membranous and “feathery” pockets which have the appearance of valves. When dissecting the genitalia it is difficult to remove the scales and hairs from these organs without tearing them. The intersegmental membrane between abdominal segments seven and eight is nearly as long as eight on *noctivolans*, and segment eight has a large, membranous, ventral, sub-hemispherical pocket.

#### KEY TO THE SPECIES OF HAWAIIAN ANOMIS

1. Fore wing with postmedial line sharply indented at costal margin, thus producing a sharp, V-shaped notch; subbasal line almost always forming a conspicuous, dark, usually black, subtriangular macula . . . . . ***noctivolans*** (Butler).
2. Fore wing with postmedial line angled inward to costa, but not notched; subbasal line inconspicuous, never forming a dark macula . . . . . ***hawaiiensis*** (Butler).

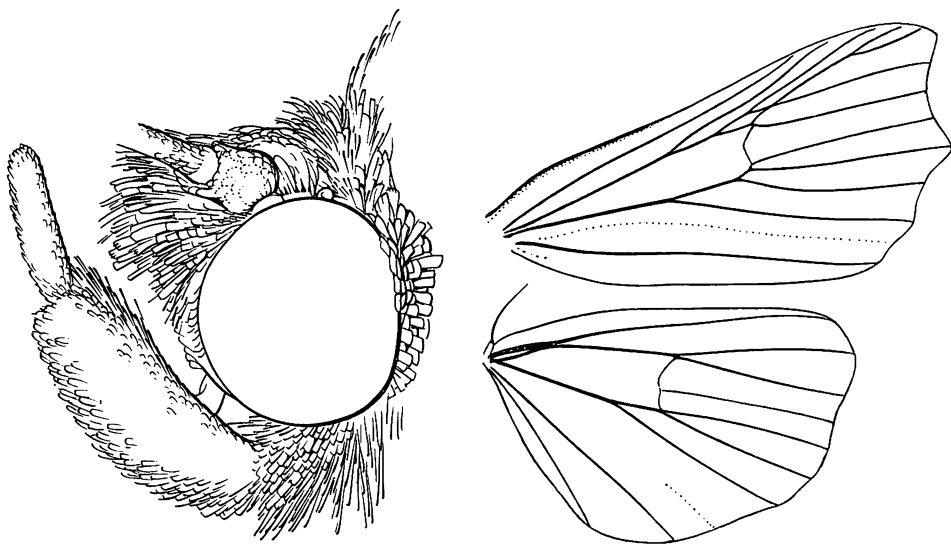


Figure 323—Left: Head of *Anomis noctivolans* (Butler). Right: Wing venation of *Anomis hawaiiensis* (Butler). Some species do not have veins 4 and 5 as parallel in the hind wing as does this species.

**Anomis hawaiiensis** (Butler), **new combination** (figs. 323, 324, 325, 326).

*Gonitis hawaiiensis* Butler, 1882:32.

Incorrectly synonymized with "*Cosmophila*" *sabulifera* (Guenée) by Meyrick, 1899:158; 1904:348.

Endemic. Kauai, Oahu (type locality: near Honolulu), Hawaii.

Hostplants: *Hibiscus* species, *Hibiscus tiliaceus*, *Hibiscadelphus*.

Parasites: *Chaetogaedia monticola* (Bigot), *Frontina archippivora* (Williston).

The caterpillar is a green, or sometimes reddish, semi-looper.

"In one instance a number of caterpillars, taken on a native *Hibiscus* (?) in a mountain forest, produced a very variable series of adults, including some remarkable aberrations. On another occasion a very large number of moths bred

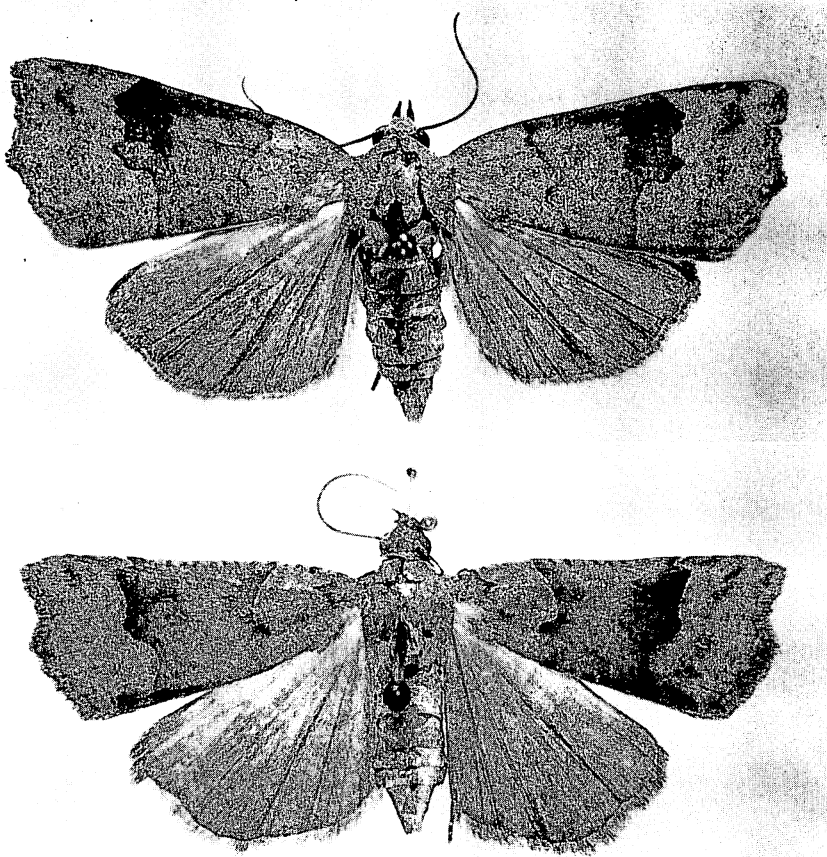


Figure 324—Above: *Anomis hawaiiensis* (Butler), female; Kilauea, Hawaii; reared from *Hibiscadelphus*; expanse, 38 mm. (The type is not this color form, but it has the fore wings almost evenly pale brownish with the small submedial dot dark and prominent.) Below: *Anomis noctivolans* (Butler), female; Kaimuki, Oahu; fore wing length, 14 mm. (Compared with type, which has the subbasal spot darker and the submedial band paler on the fore wing.)

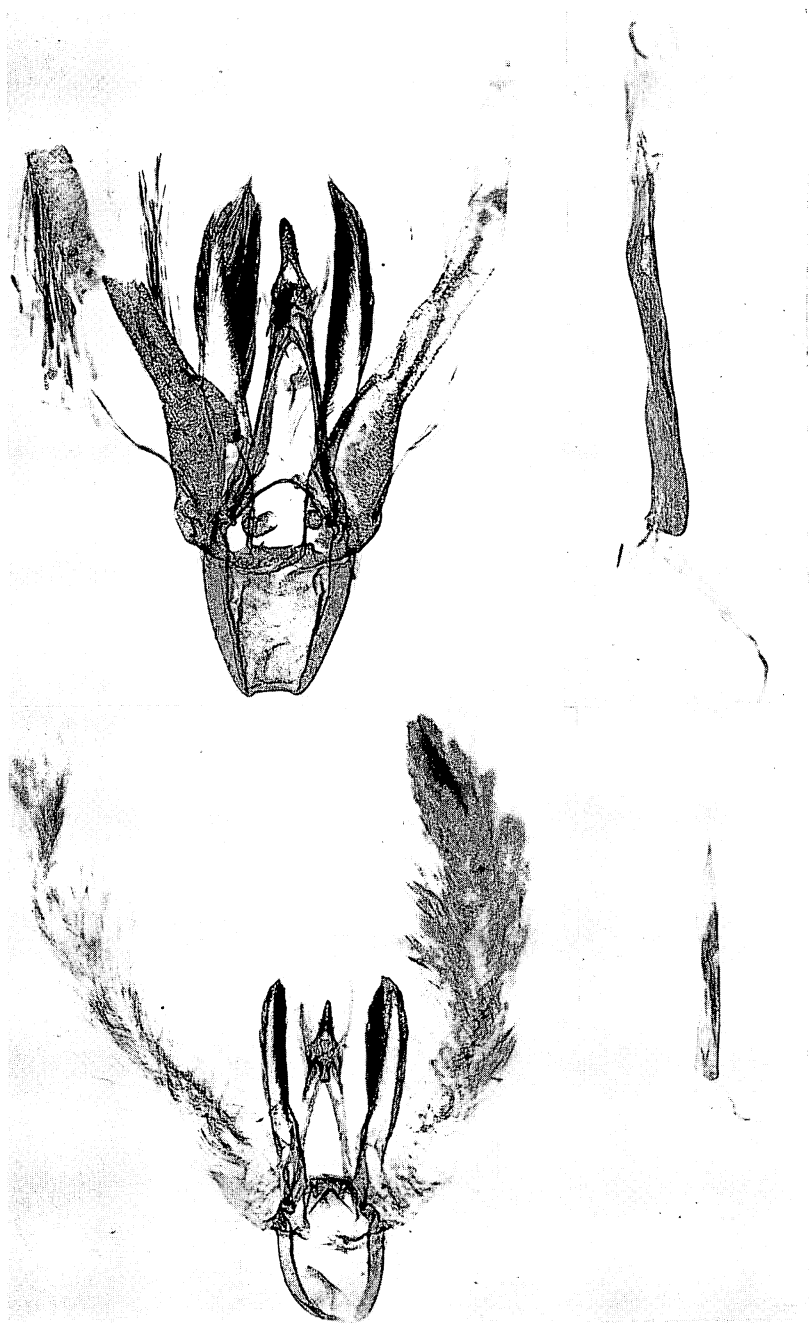


Figure 325—Male genitalia of *Anomis hawaiiensis* (Butler); Kauai (above); and of *noctivolans* (Butler); Kaholuamano, Kauai; 4,000 feet (below). The large membranous sacs are served by large tracheal trunks. Could they be inflated and protruded by air pressure?

from caterpillars, that were injuring a fine hedge of a foreign *Hibiscus*, showed no remarkable varieties. Sometimes the foliage of the 'Hau' tree (*H. tiliaceus*) is much injured by the caterpillars." (Perkins, 1913:cxlix.)



Figure 326—Female genitalia of *Anomis hawaiiensis* (Butler); northwestern Koolau Mts., Oahu.

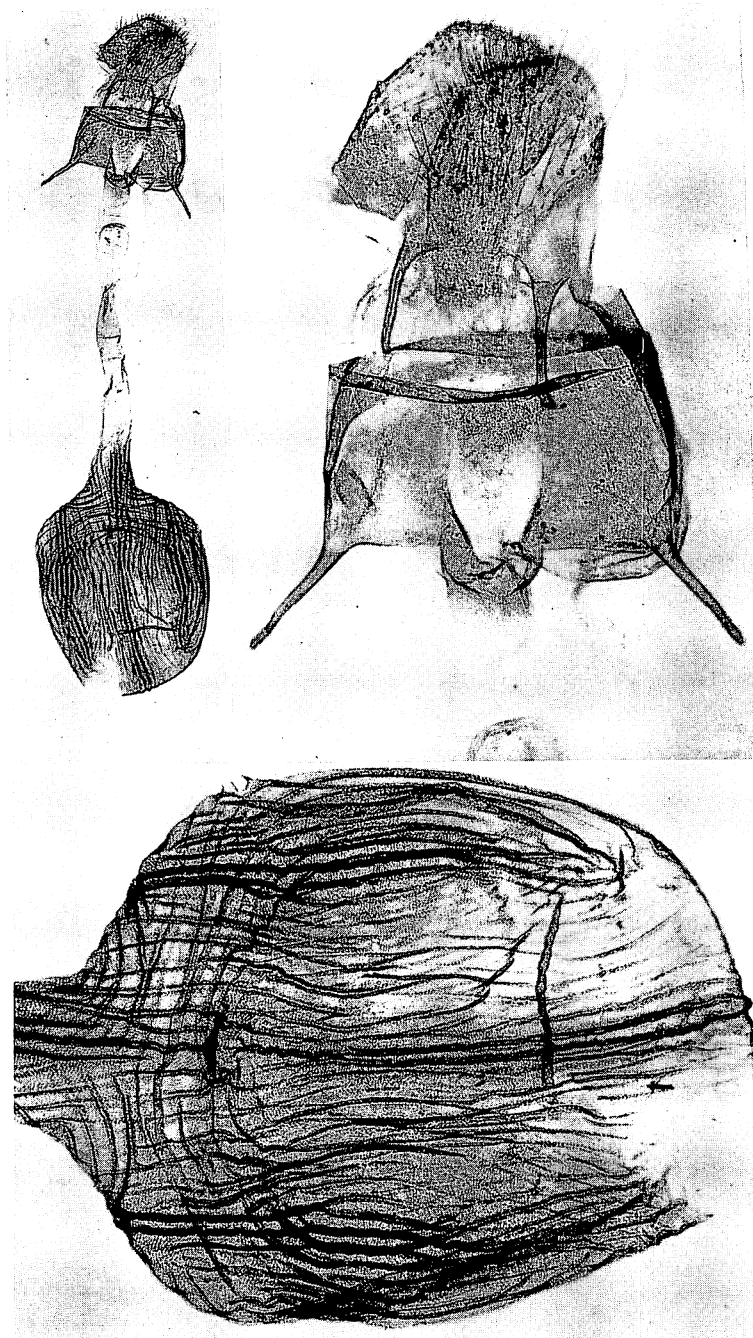


Figure 327—Female genitalia of *Anomis noctivolans* (Butler); type female from Maui.



**Anomis noctivolans** (Butler), **new combination** (figs. 323, 324, 325, 327).

*Toxocampa noctivolans* Butler, 1880:8.

*Cosmophila noctivolans* (Butler) Meyrick, 1899:158, pl. 4, fig. 16; 1904:348.

Endemic. Kauai, Oahu, Molokai, Maui (type locality: Haleakala, 4,000 feet).

Hostplants: *Hibiscus* species, *Sida* (the caterpillars have occasionally been found abundant on this plant in dry areas).

Parasites: *Chaetogaedia monticola* (Bigot), *Frontina archippivora* (Williston).

Genus **HYPOCALA** Guenée, 1852

Butler, 1892.

KEY TO THE SPECIES OF HYPOCALA FOUND IN HAWAII

1. Head and thorax pale brown with dark flecks; fore wings with much white, pale brown and reddish suffusion; yellow in hind wings is a very bright yellow; wing patterns as illustrated . . . . . **deflorata** (Fabricius).
2. Head, thorax and fore wings dark, brownish-fuscous; yellow in hind wings is a pale, rather diluted yellow; wing patterns as illustrated . . . . . **velans** Walker.

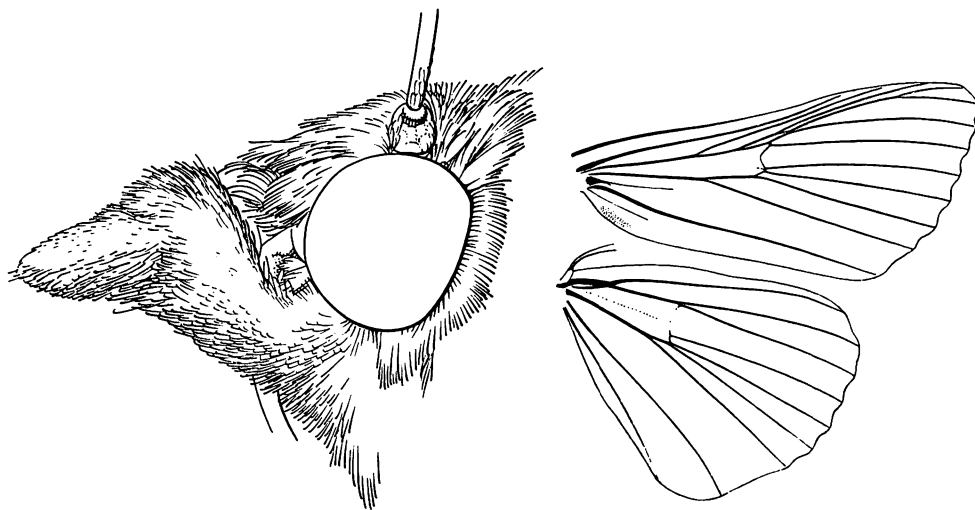


Figure 328—Head (left) and wing venation (right) of *Hypocala deflorata* (Fabricius).

**Hypocala deflorata** (Fabricius), type of *Hypocala* (figs. 328, 329, 330, 332).

*Hyblaea deflorata* Fabricius, 1794:127.

*Hypocala Moorei* Butler, 1892:21.

*Hypocala australiae* Butler, 1892:21.

Misidentified as *Hypocala andremona* (Cramer, 1782:132, pl. 358, figs. C, D, *Phalaena-Noctua*) by Meyrick, 1899:159.

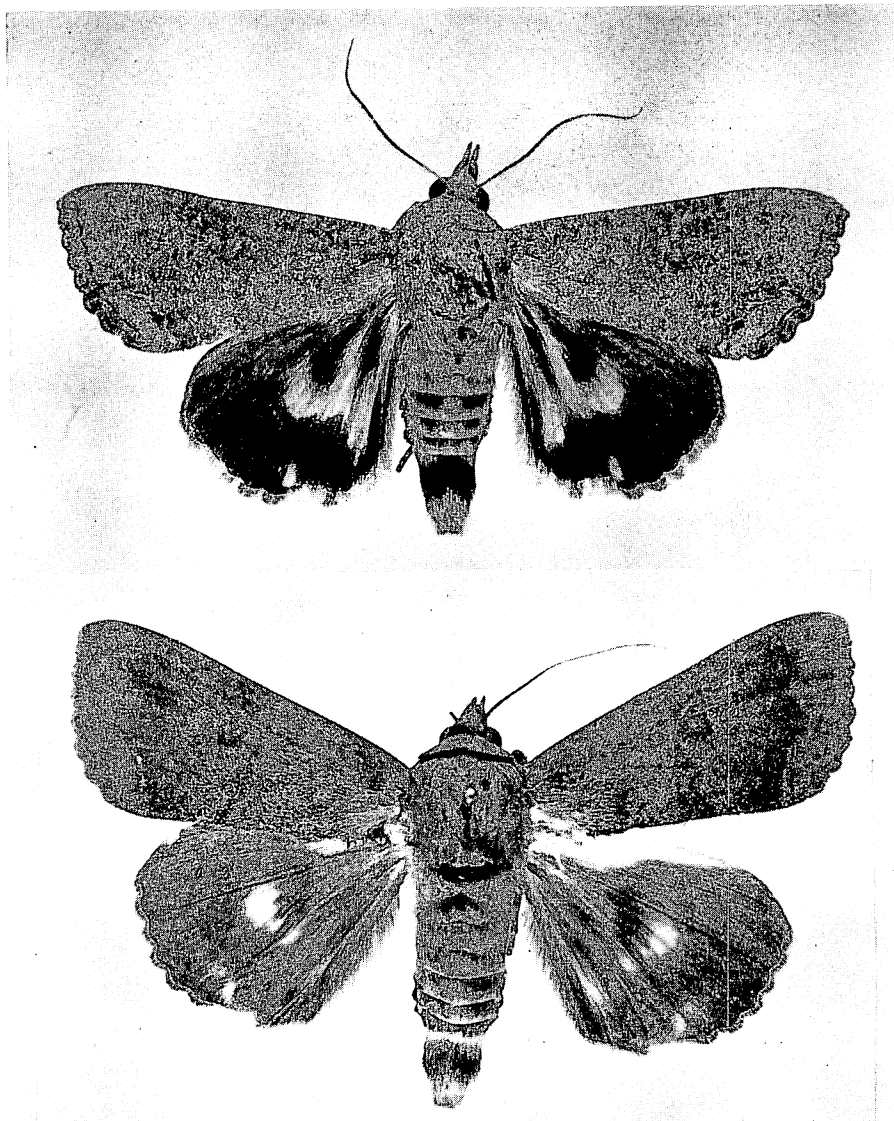


Figure 329—Above: *Hypocala deflorata* (Fabricius); Honolulu; expanse, 47 mm. Below: *velans* Walker; Hawaii; expanse, 57 mm.; compared with the type.

Oahu, Maui, Hawaii.

Immigrant. Widespread from India to Africa and to Australia and many Pacific islands. First collected in Hawaii by Blackburn, who took specimens near Honolulu.

Hostplants: *Diospyros*, *Maba sandwicensis*, *Sapota*.

Parasite: *Trichogramma minutum* Riley.

Meyrick made a mistake when he determined this species as *andremona*, which is a very similar species found in Mexico, Central and South America. He was also in error in considering *velans* as only a "native race" of this species. The name *deflorata* has not been used in Hawaiian literature heretofore, but my examination of material in the British Museum makes the change necessary.

Swezey (1909:85-86) has described the larva and pupa as follows:

Full-grown larva is about 45 mm.; cylindrical, slightly narrowed in front of the 5th segment.

Green form—Nearly uniform bright green with a yellowish tinge, more yellowish on dorsum of 5th segment. A pale yellow subdorsal line and a pale yellow line just below spiracles; three crinkled faint lines between these two, a similar line on each side of dorsal vessel; spiracles white, black margined, a black spot above and enclosing the upper part of each, often a forward projection from the upper part of the spot, more particularly on the spot above the posterior spiracle. Tubercles concolorous, inconspicuous; hairs slender; 12th segment slightly enlarged dorsally. Head concolorous, with two vertical black bars in front very wide apart. The black spots on the spiracles are larger in different specimens, varying till in some there is a continuous stripe enclosing the spiracles, pinkish on the lower part. The caterpillar turns rosy dorsally when about ready to pupate.

An intermediate form has head mostly black, and much blackish mottling on dorsal part; cervical shield mostly black-marked; the black spiracular stripe incomplete.

Another intermediate form has a complete subdorsal black stripe, spiracular stripe incomplete, several fine, much-interrupted black lines between these two stripes; an interrupted subspiracular black stripe; a few short black lines on dorsum of segments 2 to 6; conspicuous yellowish-white transverse dorsal mark on segment 5; head blackish on periphery, or nearly all blackish.

Black form—Almost entirely black, less intense below; head entirely black; a white line each side of dorsal vessel, a subdorsal white line and a fainter line between it and the preceding; several crinkled white lines on sides; more or less whitish or pinkish between segments on line of spiracles, large white patch below spiracle making an interrupted white subspiracular stripe; spiracles white; two subdorsal white spots on segment 5, often pinkish; segment 12 slightly enlarged dorsally and some whitish or pinkish on this enlargement. Two specimens had orange-yellow on middle of cervical shield on 5th segment and on hump of 12th segment.

Pupa—22 mm.; medium dark brown; wing-antenna- and leg-cases terminate roundly on apex of 4th abdominal segment; incisures between segments 4-7 movable; fine punctures scattered over surface of abdomen above and below, more numerous at base of segments; spiracles situated in smooth oval darker areas; cremaster inconspicuous, with four slightly diverging, ventrally curved, hooked spines, the two inner ones larger.

Pupation takes place in a cell in the soil, or beneath trash on the surface. The cell is supplied with a few fibers of silk. The pupal period is 13-17 days.

### **Hypocala velans** Walker (figs. 329, 331, 333).

*Hypocala velans* Walker, 1857:1177. Butler, 1892:21. Swezey, 1954:123.

*Hypocala andremona* race *velans* (Walker) Meyrick, 1899:159.

Endemic. Kauai, Oahu, Molokai, Maui, Hawaii. The type material was from "Sandwich Islands. (Capt. Beechey's Voyage). Presented by the Lords of the Admiralty." (Walker.)

Hostplant: *Maba sandwicensis*.

Meyrick erred in considering this to be a race of the American *andremona*. It

may be an endemic offshoot of *deflorata*, which is widespread in the Pacific, and may have immigrated to Hawaii on more than one occasion. Swezey (1909:87) pointed out that the two forms found in Hawaii are distinct species, and he described the larva and pupa of this species as follows:

Full-grown caterpillar—40 mm.; shorter and thicker than *andremona* [that is, *deflorata*]; of a fuscous-brown color which is nearly uniform, but on close examination is found to be made up of dark fuscous or black with numerous crinkled longitudinal lines of a lavender color; two distinct lines border the dorsal vessel and have outward angulations in the segments; just at inner margin of tubercle i in segments 5 to 11 is a small black spot, a larger spot in front of tubercle ii in segments 7–10; a spot of yellow and lavender mixed lies outwards from tubercle i in segments 5 and 12; a pale yellowish spiracular line; tubercles pale lavender with a black dot at base of setae; spiracles oval, very pale yellowish with black margin; cervical shield has a black longitudinal subdorsal band on each side; head mostly black, a few pale lavender spots in front and on upper part, paraclypeus pale, with two black spots.

Two specimens were light green with the lines which were lavender in the other specimens white instead; spiracular stripe with upper half black and lavender mixed, lower half white; one has black tubercles, in the other they are concolorous. Head green with black vertical band in middle of each lobe; one has almost whole side of head black.

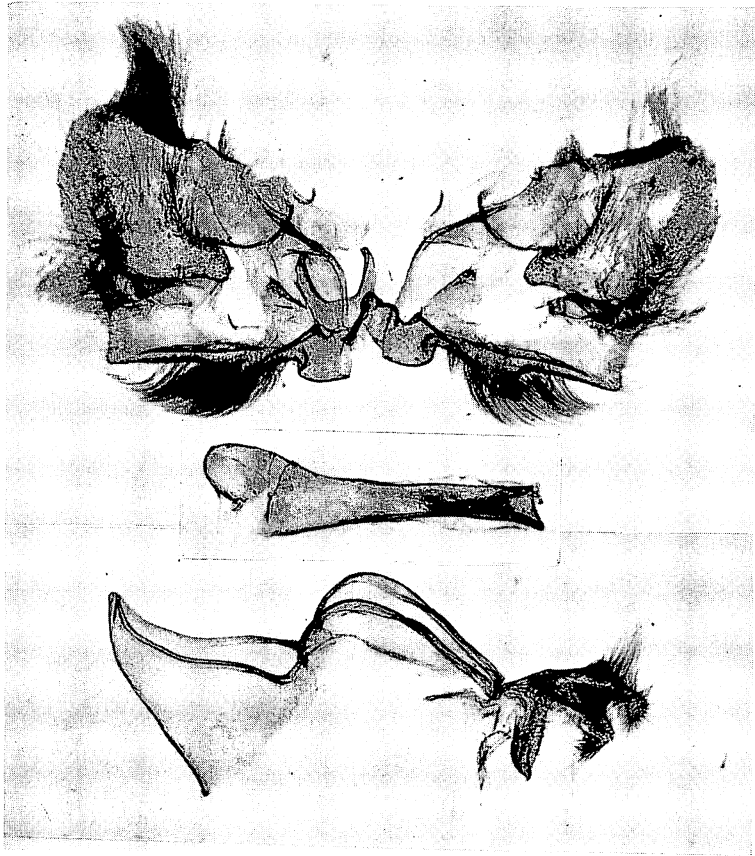


Figure 330—Male genitalia of *Hypocala deflorata* (Fabricius); Ceylon. Ventral view of main body, aedeagus, and a lateral view of uncus and associated structures.

Pupa—23–25 mm.; similar to *H. andremona*, except that it has the cremaster slightly produced (spines the same) and there is a black dorsal protuberance on posterior margin of mesothorax; the metathorax is longitudinally striate, whereas in *andremona* it is smooth. Pupa formed in cell in the soil.

Perkins (1913:cxlix) noted that *velans*

appears to be much more numerous than [*deflorata*] in most parts of the islands. In the daytime it often secretes itself amongst the lava, which is piled up to form walls in various parts of Hawaii, and from these it is very easily disturbed in the daytime. It also frequents caves and cavities in the sides of precipitous gulches, issuing from these in great numbers, as we have noticed on Molokai and elsewhere. It freely enters houses, much more often than [*deflorata*]. . . . Although most abundant on the lowlands and lower mountain slopes, we have noted the occurrence of *H. velans* in a well-known cave at an altitude of nearly 9,000 ft. on Haleakala.

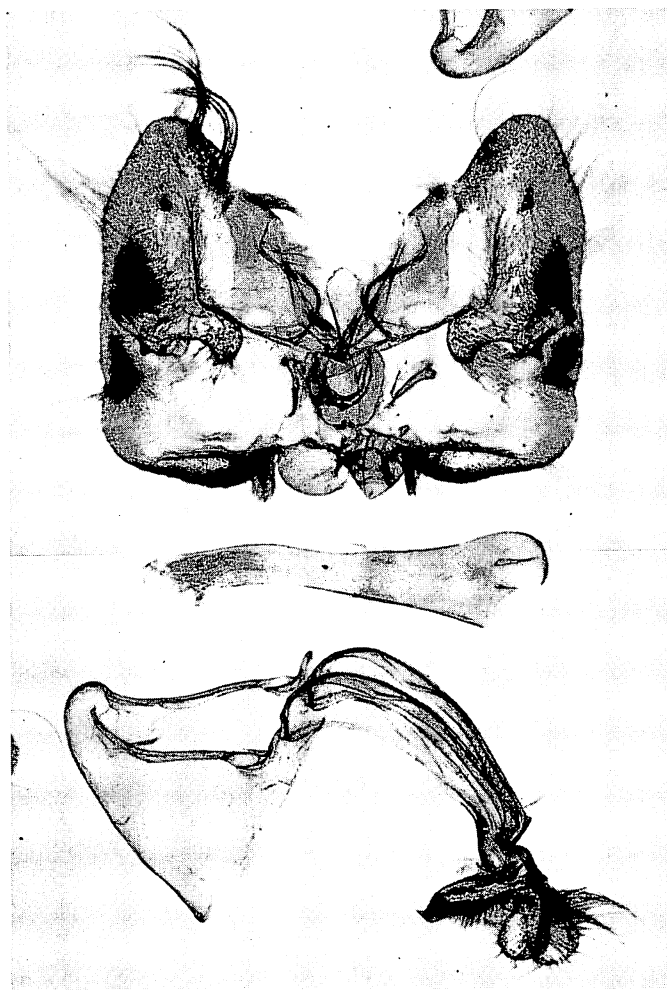


Figure 331—Male genitalia of *Hypocala velans* Walker; Kona, Hawaii; 1,500 feet. Ventral view of main body, aedeagus, and lateral view of uncus and associated structures.



Figure 332—Female genitalia of *Hypocala deflorata* (Fabricius); Honolulu.

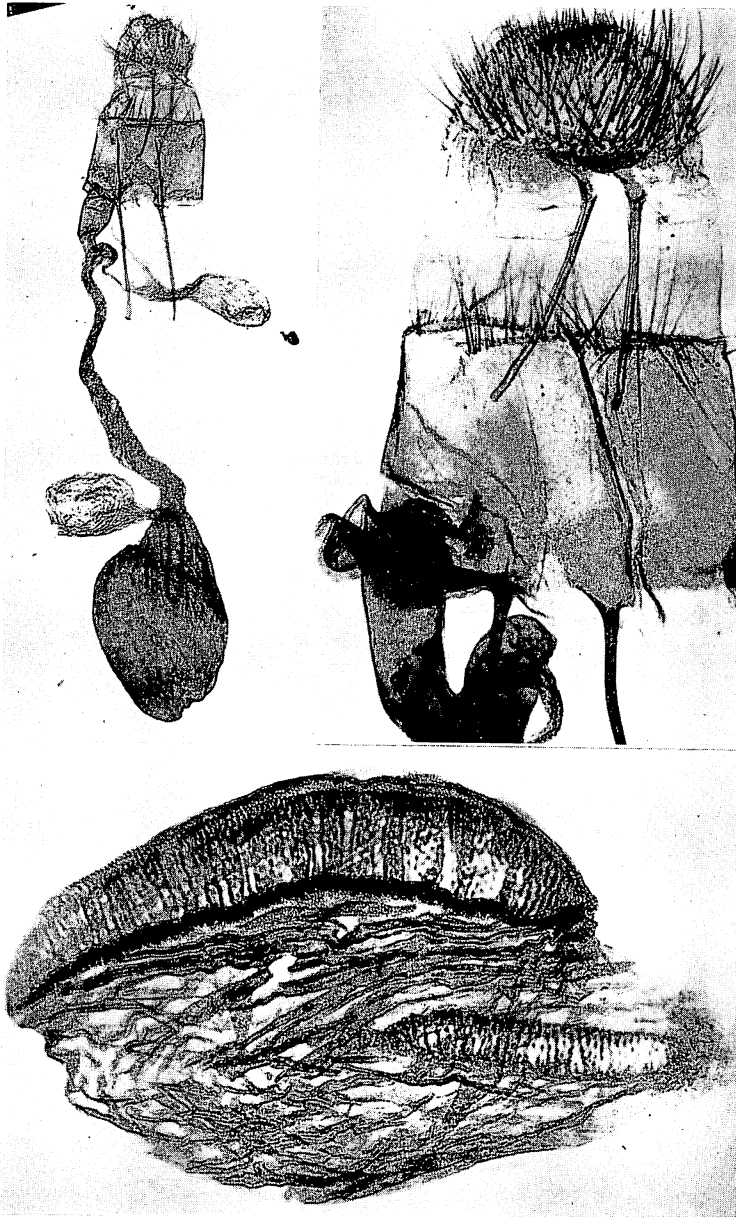


Figure 333—Female genitalia of *Hypocala velans* Walker; Honolulu.

Genus **POLYDESMA** Boisduval, 1833

**Polydesma umbricola** Boisduval (figs. 334, 335, 336, 337, 338).

*Polydesma Umbricola* Boisduval, 1833:108, pl. 13, fig. 5.

Eltringham, 1937:140, pl. 2, figs. 1-3, notes on morphology.

Kauai, Niihau, Oahu, Molokai, Maui, Hawaii.

Immigrant; widespread from Africa through the Pacific to Tahiti. First recorded in Hawaii in 1946 by Van Zwaluwenburg from specimens collected in Honolulu in 1945.

Hostplants: *Cassia grandis* (pink shower), *Pithecolobium dulce*, rose, *Samanea saman* (monkey pod).

Parasites: *Brachymeria obscurata* (Walker), *Chaetogaedia monticola* (Bigot), *Ephialtes hawaiiensis* (Cameron), *Eucelatoria armigera* (Coquillett), *Hyposoter exiguae* (Viereck).

Soon after the appearance of this large moth in Hawaii, its devastation to the foliage of the beautiful and valuable monkey pod trees became alarming. The feeding of the caterpillars stripped the trees of their foliage, and the continued gnawing of the sprouting leaves caused peculiar swellings of the twigs. Limbs and

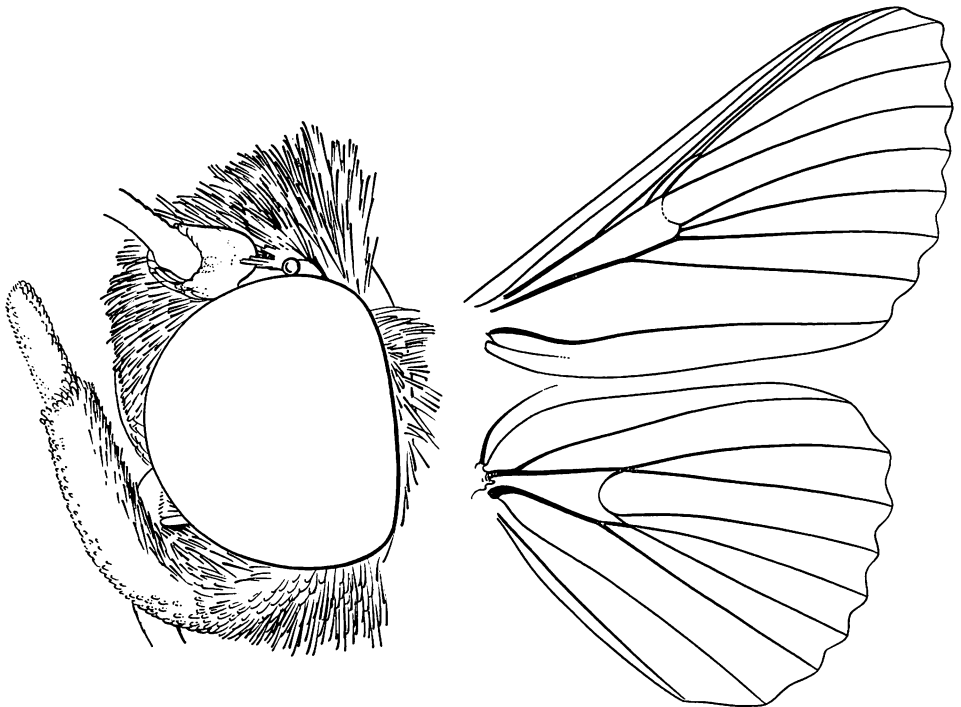


Figure 334—Head (left) and wing venation (right) of *Polydesma umbricola* Boisduval.



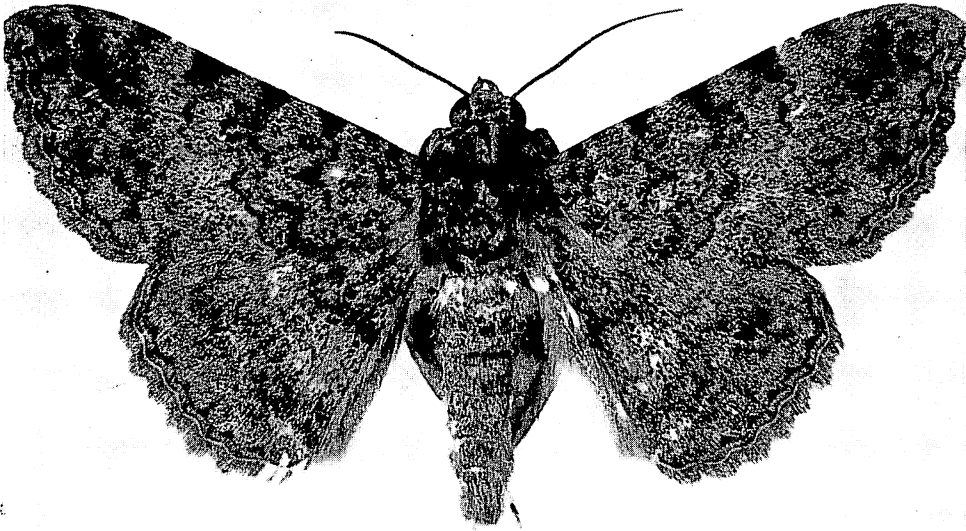


Figure 335—*Polydesma umbricola* Boisduval, Honolulu.

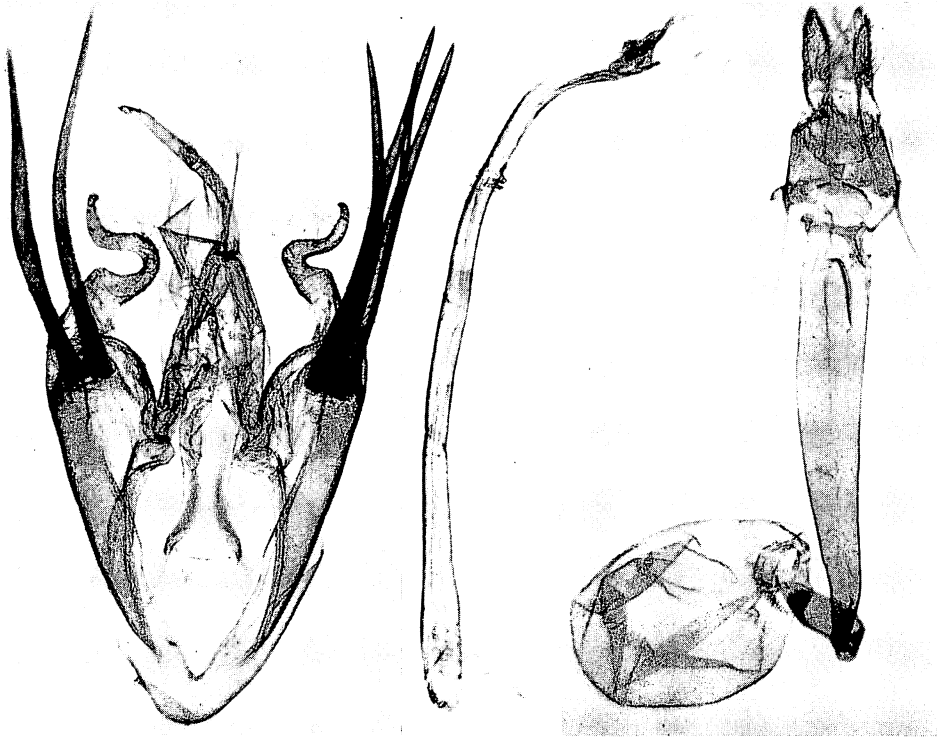


Figure 336—Male (left) and female (right) genitalia of *Polydesma umbricola* Boisduval from Tahiti; aedeagus at center.

entire trees were killed by the early serious attacks. The illustrations show the types of damage caused by the caterpillars. Fortunately, the damage is not now as great as before the species was brought into balance by the parasites. Notes on the habits of the species are included in various minutes of the Hawaiian Entomological Society from 1946 onward.

Genus **SIMPLICIA** Guenée, 1854

***Simplicia lautokiensis*** Prout (figs. 339, 340, 341).

*Simplicia lautokiensis* Prout, 1933:85. Tams, 1935:232, pl. 12, figs. 12, 13.

Kauai, Oahu, Hawaii.

Immigrant. Described from Fiji and known also from Samoa. First recorded from Hawaii by Butler (1877:48) under the erroneous determination of *Herminia caeneusalis* Walker, and listed by Meyrick (1899:153) as *Simplicia robustalis* Guenée.

Hostplant: Dead leaves of chayote vine.

Parasite: *Chalcis obscurata* Guenée.

Some authors place this genus in the Hypeninae, but I believe that the course

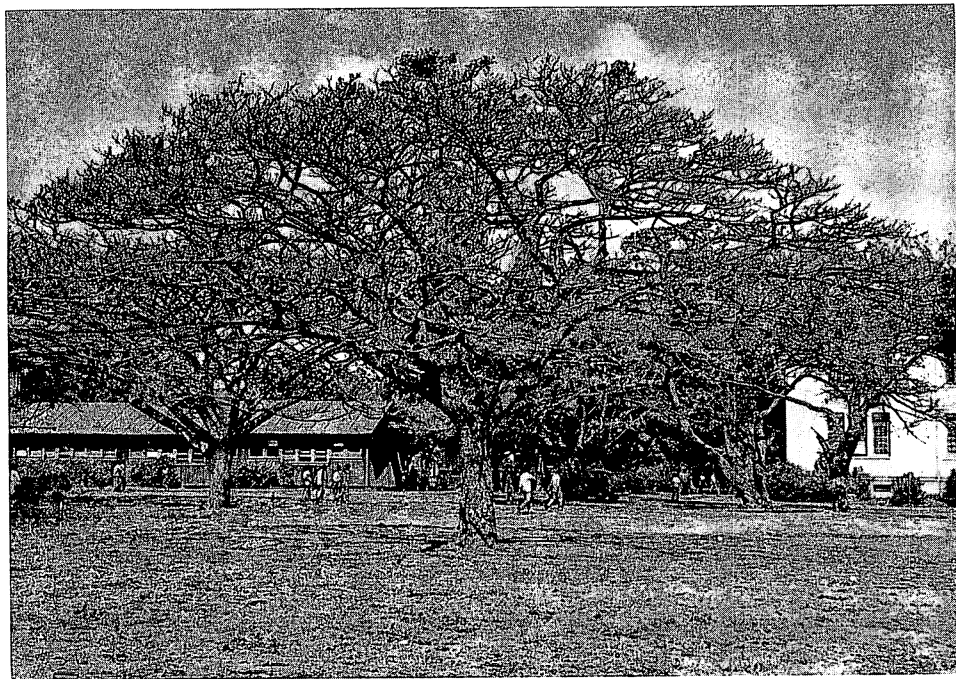


Figure 337—Monkey pod tree (*Samanea saman*) defoliated by the larvae of *Polydesma umbricola* Boisduval; Honolulu, April, 1946.

of vein five in the hind wing (see the illustration) indicates that it appears to be incorrectly placed in that subfamily.

Perkins (1913:cxlviii) says that larvae were found "swarming" on plants imported from Fiji.

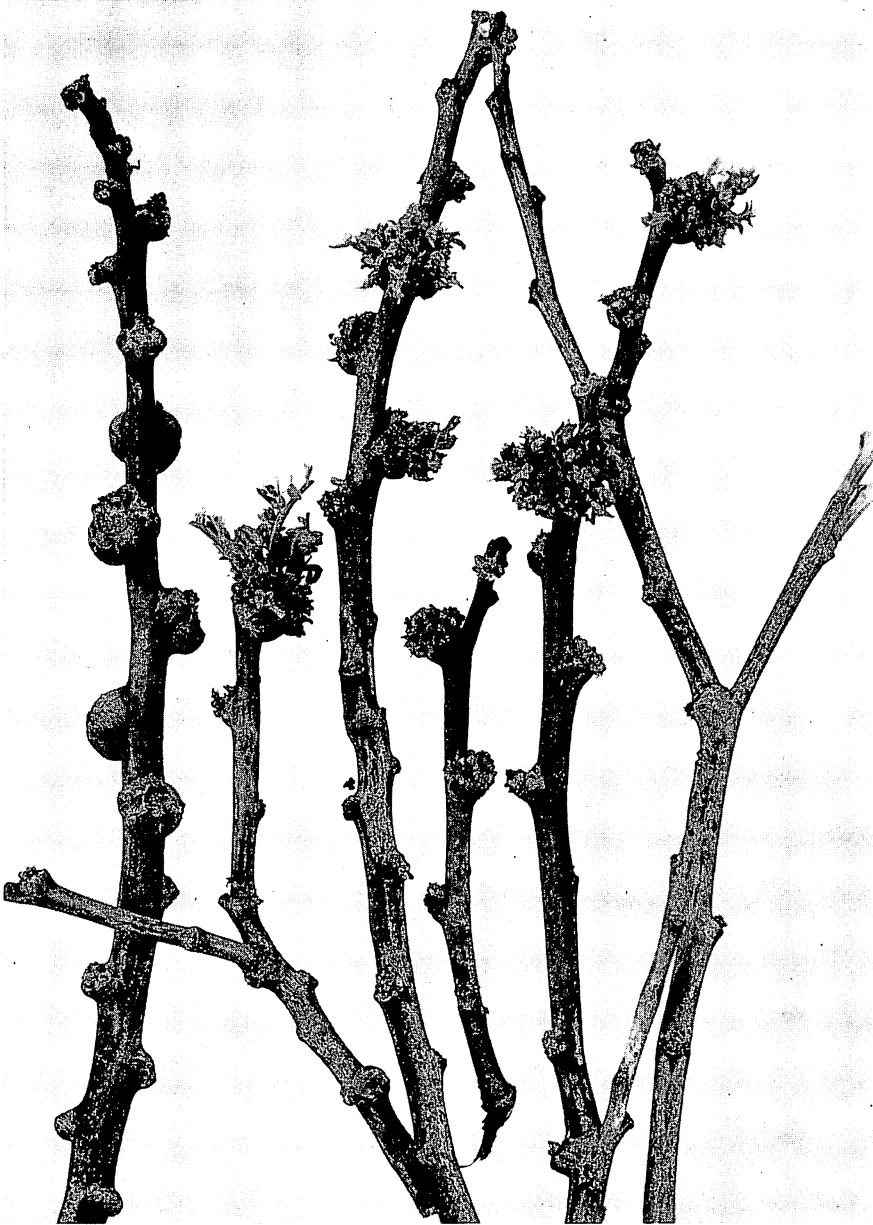


Figure 338—Twigs of a monkey pod tree (*Samanea saman*) showing distortion of leaf buds following damage by the feeding of *Polydesma umbricola* Boisduval larvae; Honolulu, 1946.

## Subfamily HYPENINAE

*Hyperidae* Herrich-Schaeffer, 1851:425. Walker, 1858:11. Kirby, 1897:187.  
*Polypogoninae* Hampson, 1918:384.

For notes on pupae of some foreign species, see Mosher, 1916:116.

Genus **HYPENA** Schrank, 1802:163

*Nesamiptis* Meyrick, 1899:156, type *plagiota* Meyrick. **New synonym.**

A study of the type of *Hypena* (*proboscidalis* Schrank, 1802:163; cited by Curtis, 1829, and repeated by Duponchel, 1831; the citation of *rostralis* by Grote, 1895, is incorrect) leads me to consider Meyrick's *Nesamiptis* unnecessary.

The known caterpillars of our species feed upon grasses.

## KEY TO THE HAWAIIAN SPECIES OF HYPENA

1. Outer margin of the discal dark shade or band (or the faint indication of it) on upper side of fore wings forming a straight or very nearly straight diagonal line, as illustrated.....**plagiota** (Meyrick).  
 Outer margin of this area sinuous or concave, obviously not nearly straight.....2

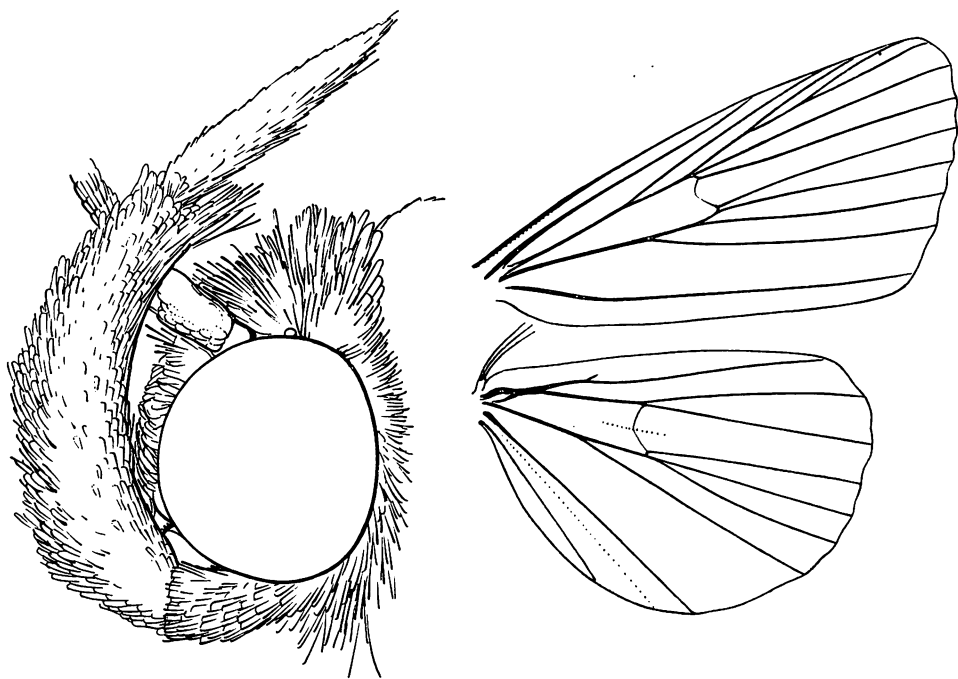


Figure 339—Head (left) and wing venation (right) of *Simplicia lautokiensis* Prout.

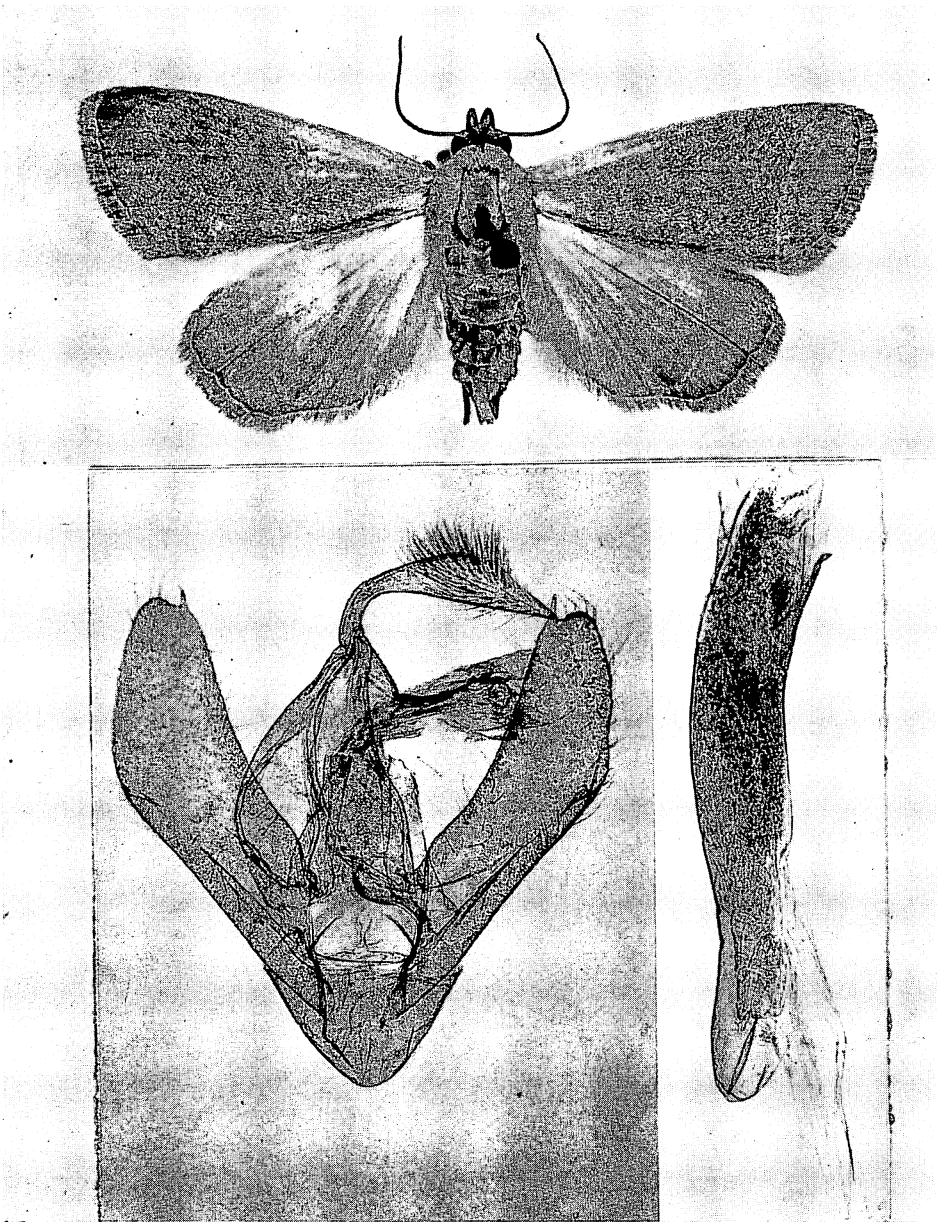


Figure 340—*Simplicia lautokiensis* Prout. A specimen reared from papaia at Honolulu and compared with the type; expanse, 32 mm. Below: Male genitalia of another example.

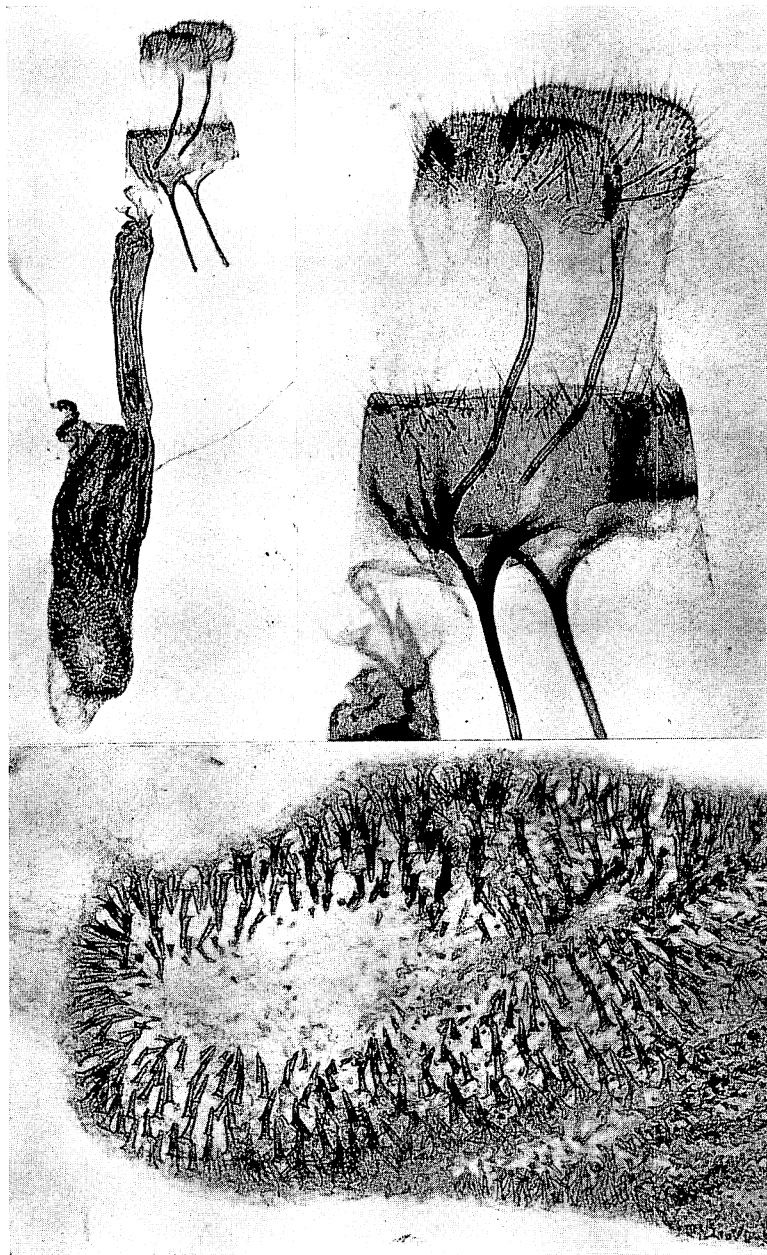


Figure 341—*Simplicia lautokiensis* Prout. Female genitalia of the Fijian type.

- 2(1). Wings quite pale in background, with the dark discal band on fore wings with outer side more nearly simply concave than sinuous and pattern as figured.....  
 .....**newelli** (Swezey).  
 Outer side of dark discal band in fore wing obviously sinuous.....3
- 3(2). Outer side of dark discal band in fore wing multiply sinuate across entire wing.....**laysanensis** (Swezey).  
 Outer side of dark discal band in fore wing nearly straight or only slightly arcuate from costa to near half way across wing, thence sinuate to hind margin.....4
- 4(3). Expanse about 35 mm. or more; outer side of dark discal band meeting costa at a very sharp angle of less than 45 degrees, as illustrated.....**senicula** (Meyrick).  
 Expanse not over 30 mm.; outer side of dark discal band on fore wing, or the faint line representing it, meeting costa at a much less acute angle of about 60 degrees, but somewhat variable, as illustrated...**obsoleta** Butler.

***Hypena laysanensis* (Swezey), new combination** (fig. 344).

*Nesamiptis laysanensis* Swezey, 1914:18.

Endemic. Laysan (type locality).

Hostplant: *Sporobolus*.

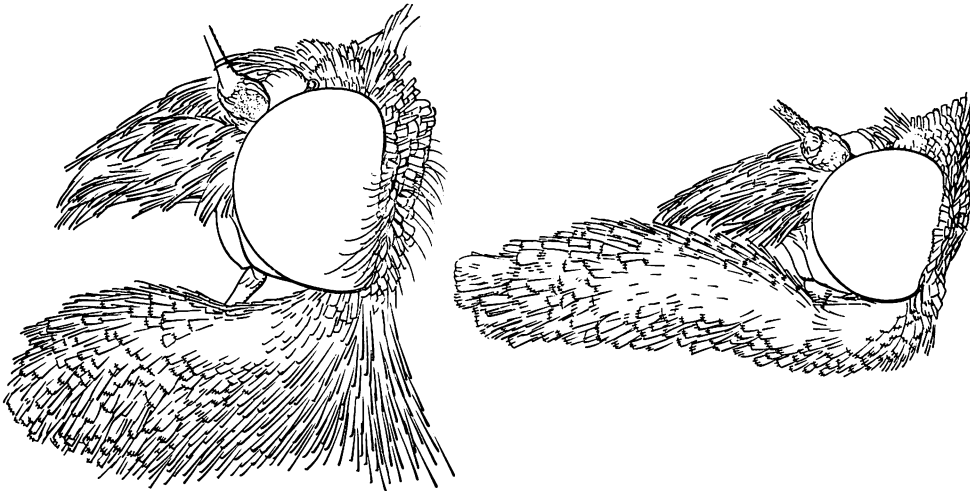


Figure 342—Head of male (left), and female (right) *Hypena obsoleta* Butler; note sexual differences.

**Hypena newelli** (Swezey), **new combination** (fig. 344).

*Nesamiptis newelli* Swezey, 1912:270.

Endemic. Hawaii (type locality: Hilo).

Hostplant: Unknown.

**Hypena obsoleta** Butler (figs. 342, 345).

*Hypena obsoleta* Butler, 1877:47; 1881:324.

*Hypena insignis* Butler, 1877:48. Synonymy by Meyrick, 1899:157.

*Nesamiptis obsoleta* (Butler) Meyrick, 1899:157, pl. 3, figs. 2, 2a-g.

Endemic. Kauai, Oahu (type locality), Molokai, Maui, Lanai, Hawaii.

Hostplants: *Paspalum conjugatum* and other grasses in the mountains.

Parasites: *Hyposoter exiguae* (Viereck) (?), *Olesicampe blackburni* (Cameron).

This is one of the most variable of all Hawaiian insects. The color forms are most confusing, and it often appears that several species are represented in assembled series. The markings on some examples are extremely bold, but they are obsolete on other specimens, and all kinds of intergrades occur. Meyrick has figured a number of color forms. Dr. Swezey once crossed various extreme forms and reared a large number of offspring which varied as do natural populations.

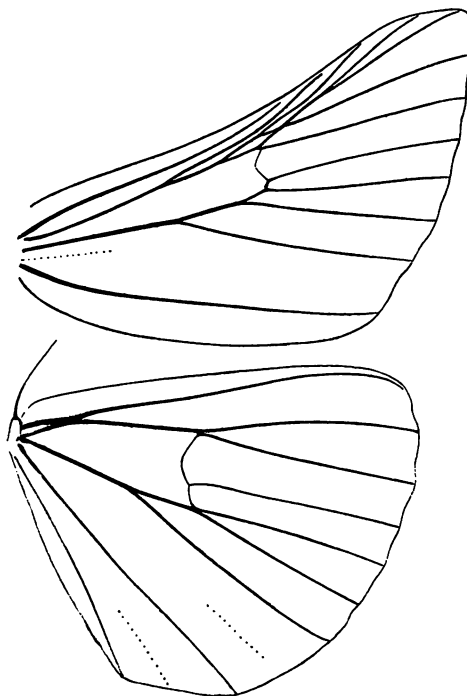


Figure 343—Wing venation of *Hypena plagiota* (Meyrick).



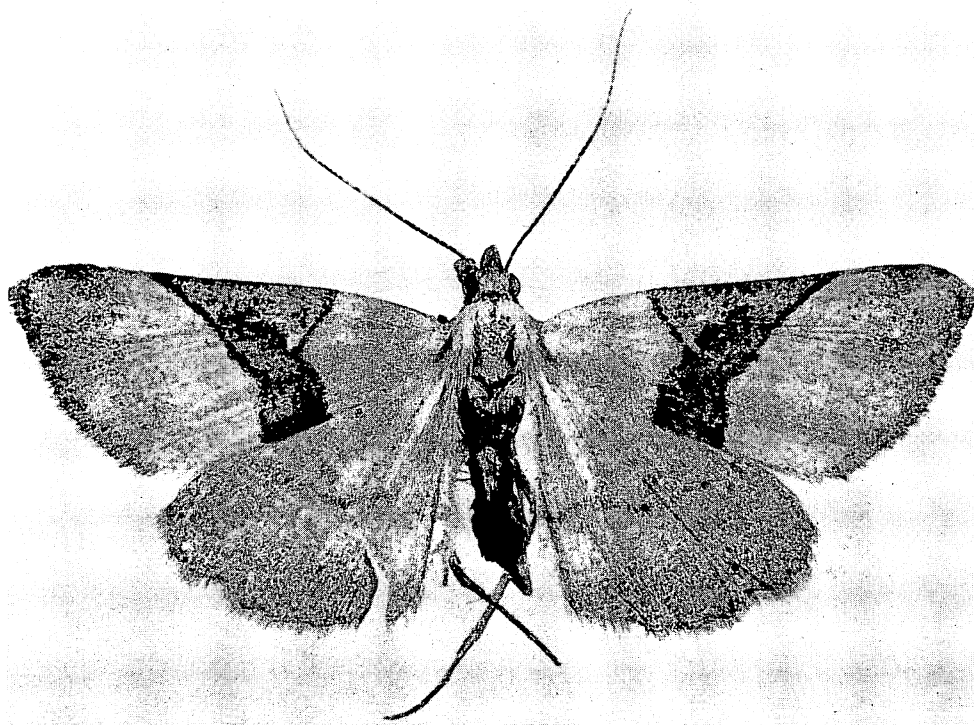
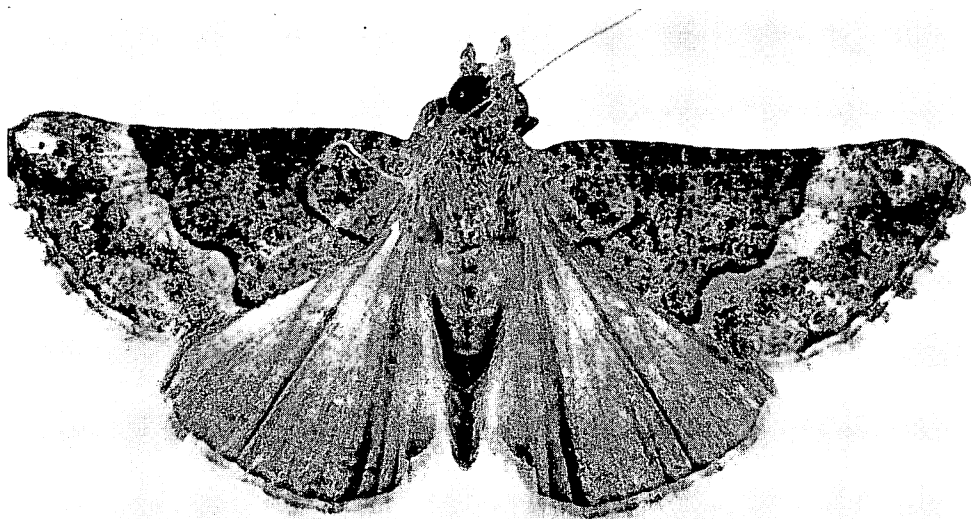


Figure 344—Above: *Hypena laysanensis* (Swezey); type, from Laysan Island; expanse, 23 mm. Below: The type of *Hypena newelli* (Swezey), from Hilo, Hawaii; expanse, 31 mm.

***Hypena plagiota*** (Meyrick), **new combination** (figs. 343, 346, 347).

*Nesamiptis plagiota* Meyrick, 1899:156, pl. 4, fig. 15. Type of *Nesamiptis*.

*Nesamiptis proterortha* Meyrick, 1928:93. **New synonym.**

Endemic. Kauai, Oahu (type locality: Waianae Mountains, over 3,000 feet), Maui.

Hostplant: *Eragrostis*.

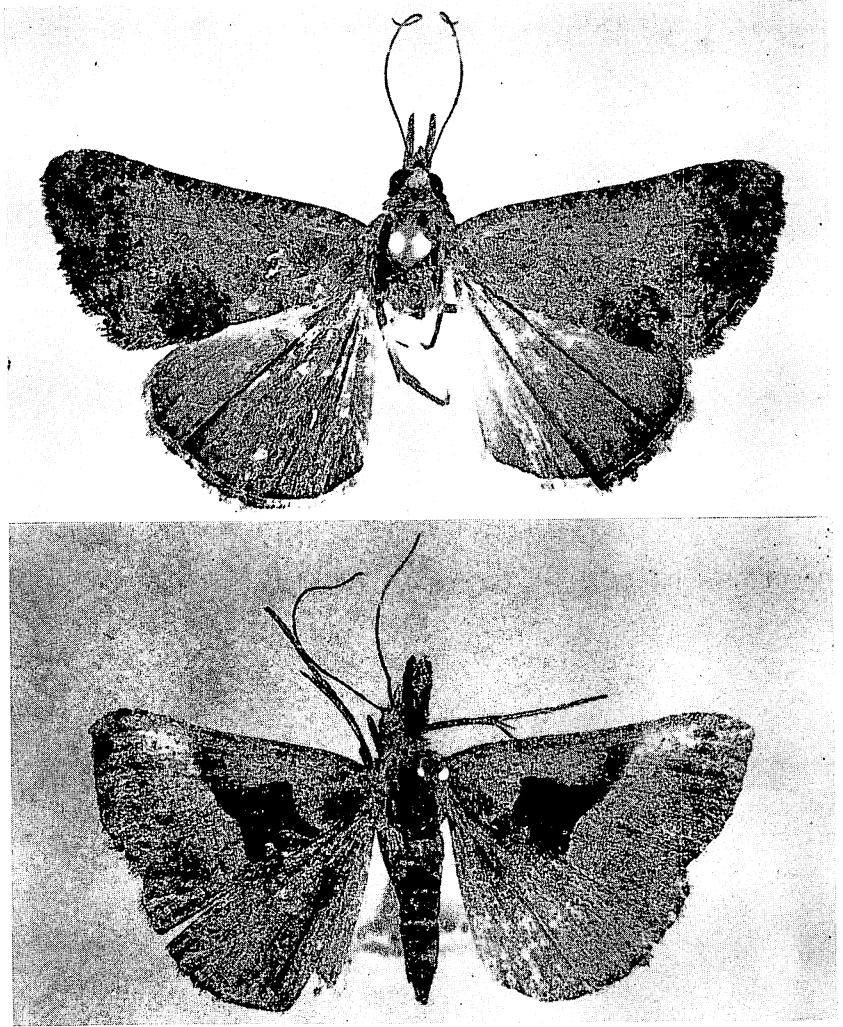


Figure 345—Above: The female type of *Hypena obsoleta* Butler, "77-43 Sandw. Islands L. 14" (Blackburn); expanse, 26 mm. Below: The type of the synonym *insignis* Butler, which bears identical data; expanse, 23.5 mm.

This is a highly variable species, and I consider *proterortha* to be a form of it and a new synonym. Although Meyrick said that he had two examples of *proterortha* when he described it, I have seen only the worn and somewhat damaged female holotype in the Sugar Planters' Experiment Station in Honolulu and have been unable to locate the second example in Meyrick's collection in the British Museum.

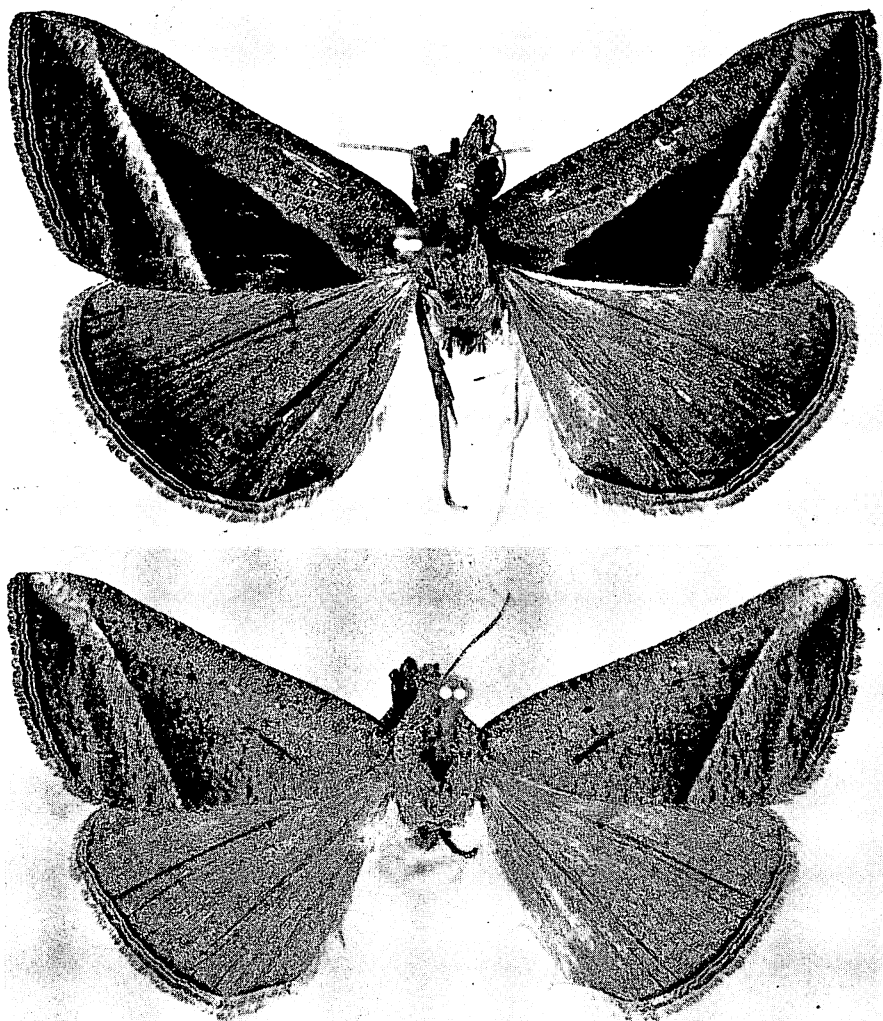


Figure 346—Above: *Hypena plagiota* (Meyrick), male type; Waianae Mts., Oahu, above 3,000 feet; expanse, 29 mm. Below: A female paratype collected with the type. The genitalia of these examples are figured on other plates.

**Hypena senicula** (Meyrick), **new combination** (fig. 347).

*Nesamiptis senicula* Meyrick, 1928:93.

Endemic. Kauai (type locality: Kaholuamano).

Hostplant: Unknown.

One example of this species was mixed with the series of *obsoleta* determined by Meyrick for *Fauna Hawaiiensis*. This is probably the example referred to by him as "one exceptional specimen 34 mm." Although this species may at first appear to be one of the many color forms of *obsoleta*, it can be separated by its obviously larger size and by the sharp angle at which the outer edge of the dark discal band on the fore wing meets the costa.

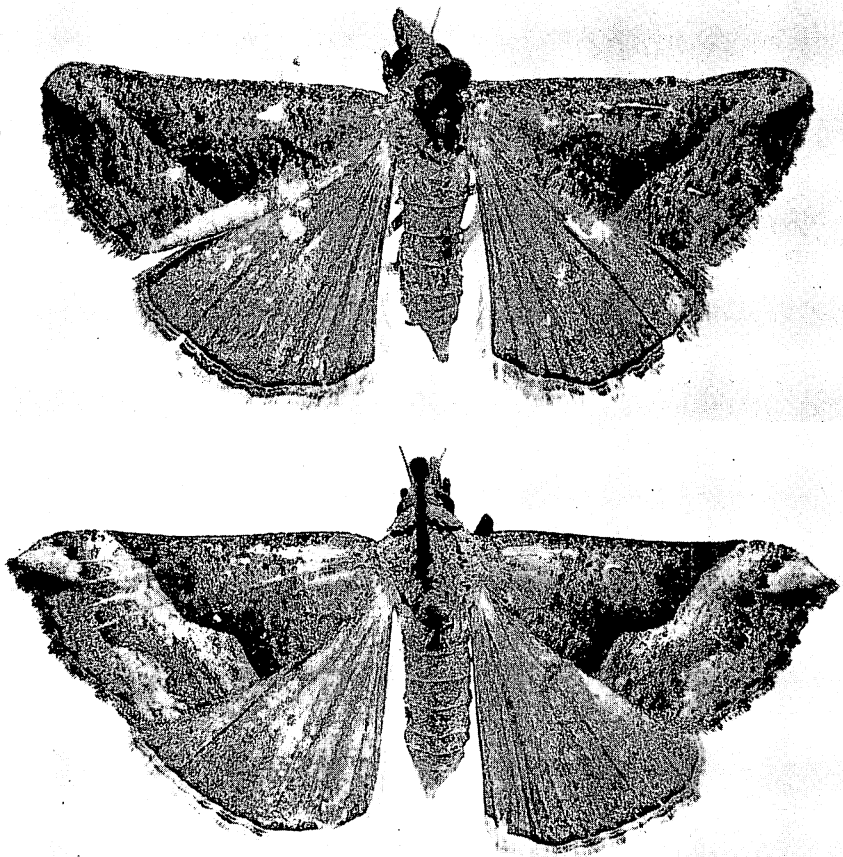


Figure 347—Above: *Hypena plagiota* (Meyrick), from the female type of the synonym *proteroritha* Meyrick; Kaholuamano, Kauai; expanse, 30 mm. Below: The female type of *senicula* (Meyrick), from the same locality; expanse, 40 mm.

Genus **SCHRANKIA** Huebner, 1825:345

In *Fauna Hawaiensis* (1899:153–156), Meyrick listed five Hawaiian species in *Hyphenodes* and, in 1904, he added a sixth species. None of these species belongs to *Hyphenodes*. It has been necessary to erect a new genus for three of them (see *Pseudoschrankia* below) and the others belong to *Schrankia*. Much difficulty was encountered in working out the confused state of affairs surrounding the genera *Schrankia* and *Hyphenodes*, which I studied before the papers of Franclemont (1949) and Ferguson (1954) appeared; had these papers been available to me, much time-consuming research would have been avoided. A summary of my investigations into the complex synonymy and nomenclature of *Schrankia* Huebner and *Hyphenodes* Doubleday follows:

Although outwardly rather similar, the members of *Schrankia* and *Hyphenodes* have distinctive morphological features, and their genitalia are based upon different plans. Two obviously distinct genera are involved.

**Schrankia** Huebner, 1825:345. Type: *Pyalis taenialis* (originally spelled *Tänialis*) Huebner, 1800–1809 (exact date not determined), the only included species (illustrated on pl. 23, fig. 151; no text). Speyer and Speyer (1862:246) list *taenialis* in *Hyphenodes* and list *costaestrigalis* Stephens as a synonym. Staudinger and Wocke (1871:142) do not mention the genus *Schrankia*, nor do they list *taenialis* Huebner, but they place *taenialis* Speyer and Speyer (1862:246, 265), as a synonym of *Hyphenodes costaestrigalis* Stephens ("certo non. Hb. Pyr. 151"), under which they also list *acuminalis* Wocke as a synonym. In the third edition of this work (Staudinger and Rebel, 1901:258), *Schrankia* is not mentioned, but *taenialis* is kept in *Hyphenodes* and listed as distinct from *costaestrigalis*; *acuminalis* Herrich-Schaeffer and *albistrigatis* Haworth are listed as synonyms of *taenialis*.

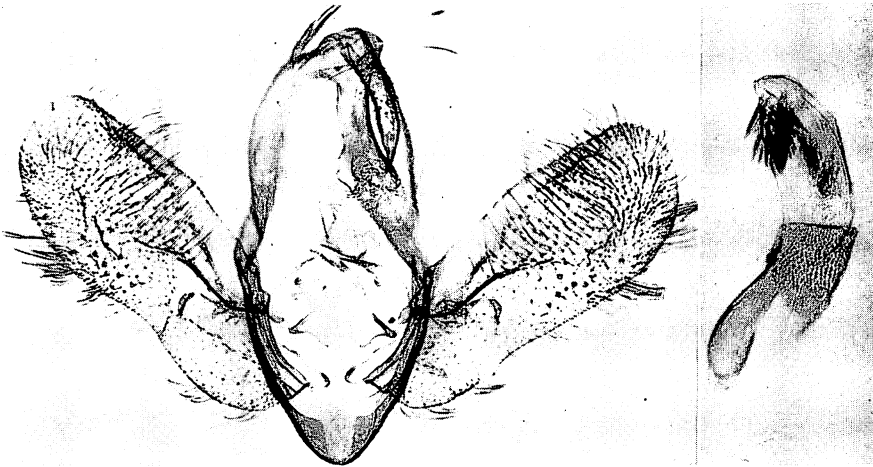


Figure 348—Male genitalia of *Hyphena proboscidalis* Schrank, the type of the genus; an English example.

Walker (1858:69-70) lists "*albistrigatus*" Haworth (and under this he lists in synonymy Huebner's *taenialis* as "*Pyalis taenialis*?") and *costaestrigalis* Stephens (with *acuminalis* Herrich-Schaeffer as a synonym) under "*Hyphenodes*." Duponchel (1845:203) lists *taenialis* in *Nymphula* in error. It is to *Schrankia* that most of the Hawaiian species heretofore placed in *Hyphenodes* belong. Hampson placed our species in *Chusaris* Walker (1858:215; type *retatalis* Walker, from Ceylon), in his arrangement of the British Museum collection, but he was incorrect in doing this, because *Chusaris* is yet another genus.

The situation regarding *Hyphenodes* is more confusing, as follows:

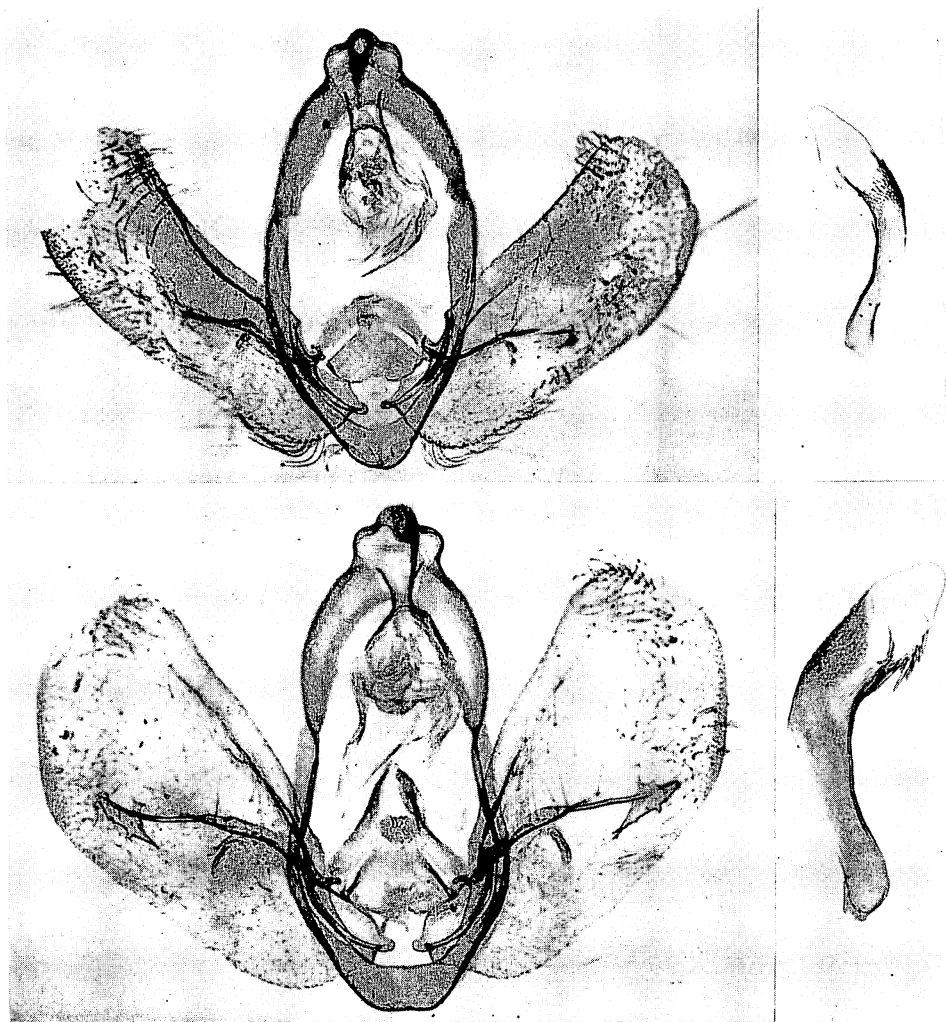


Figure 349—Male genitalia of *Hyphenodes*. Above: *obsoleta* Butler, "Sandw. Islands 81-7-14" (Blackburn). Below: The type of *plagiota* (Meyrick), Waianae Mts., Oahu, above 3,000 feet.

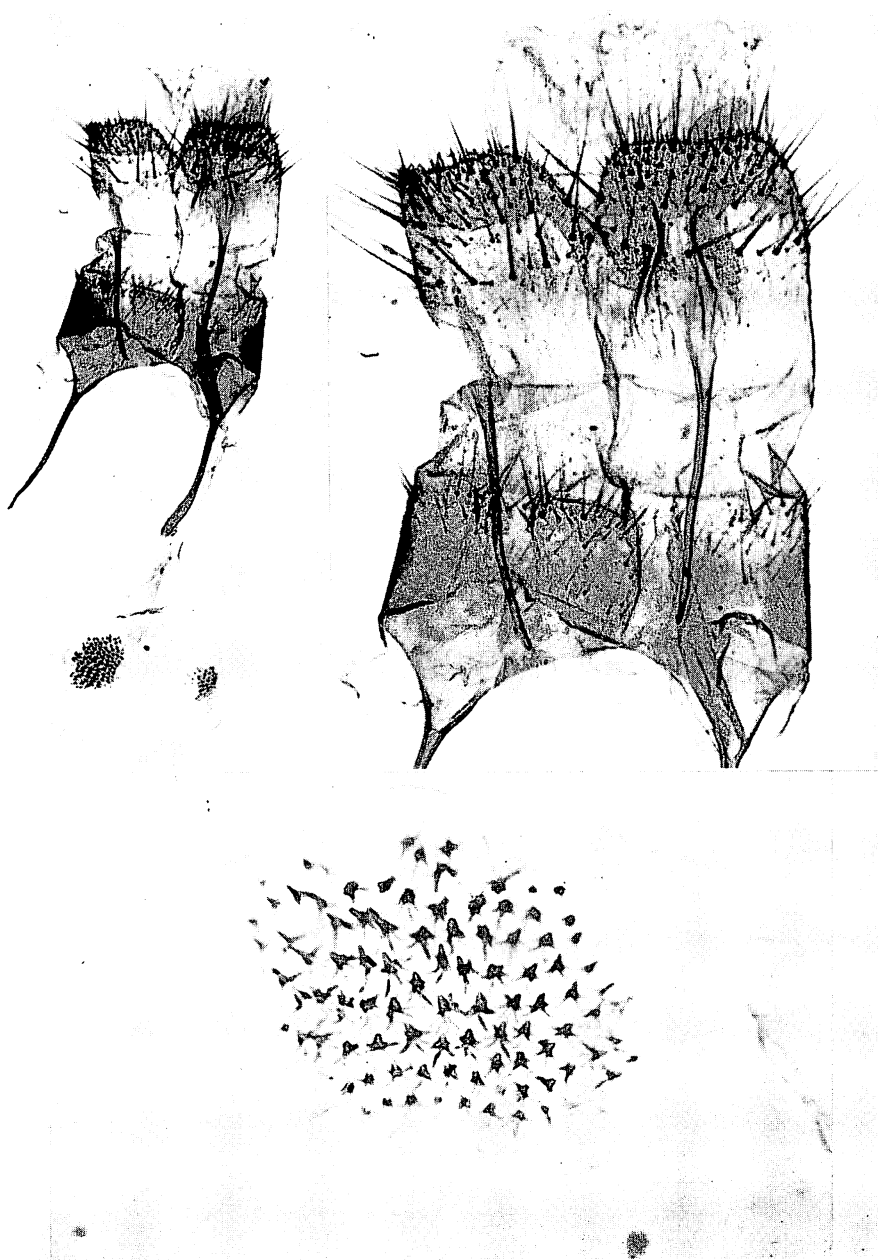


Figure 350—Female genitalia of the type of *Hypena obsoleta* Butler, Oahu.

**Hypenodes** Doubleday, 1850; type: *Hypenodes humidalis* Doubleday, 1850.  
*Schranksia* Herrich-Schaeffer, 1851; type: *Hypena turfosalis* Wocke, 1850; not  
*Schranksia* Huebner, 1825.

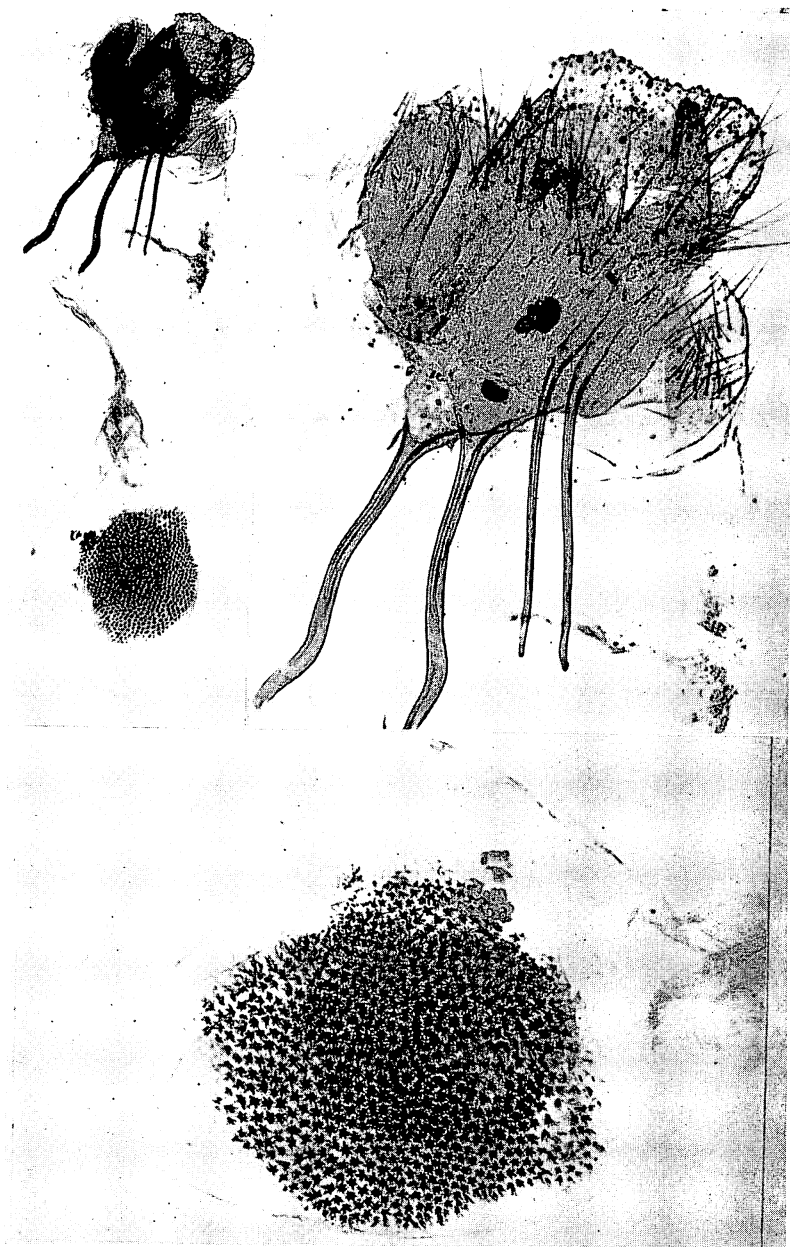


Figure 351—The female genitalia of a paratype of *Hypena plagiola* (Meyrick). See figure 346 for the specimen from which the genitalia were removed.



*Tholomiges* Lederer, 1857 (then a new name for *Schrankia* Herrich-Schaeffer);  
type: *Hypena turfosalis* Wocke, 1850.

*Menopsimus* Dyar, 1907; type *Menopsimus caducus* Dyar (from America).  
Synonymy by Franclemont, 1949:74.

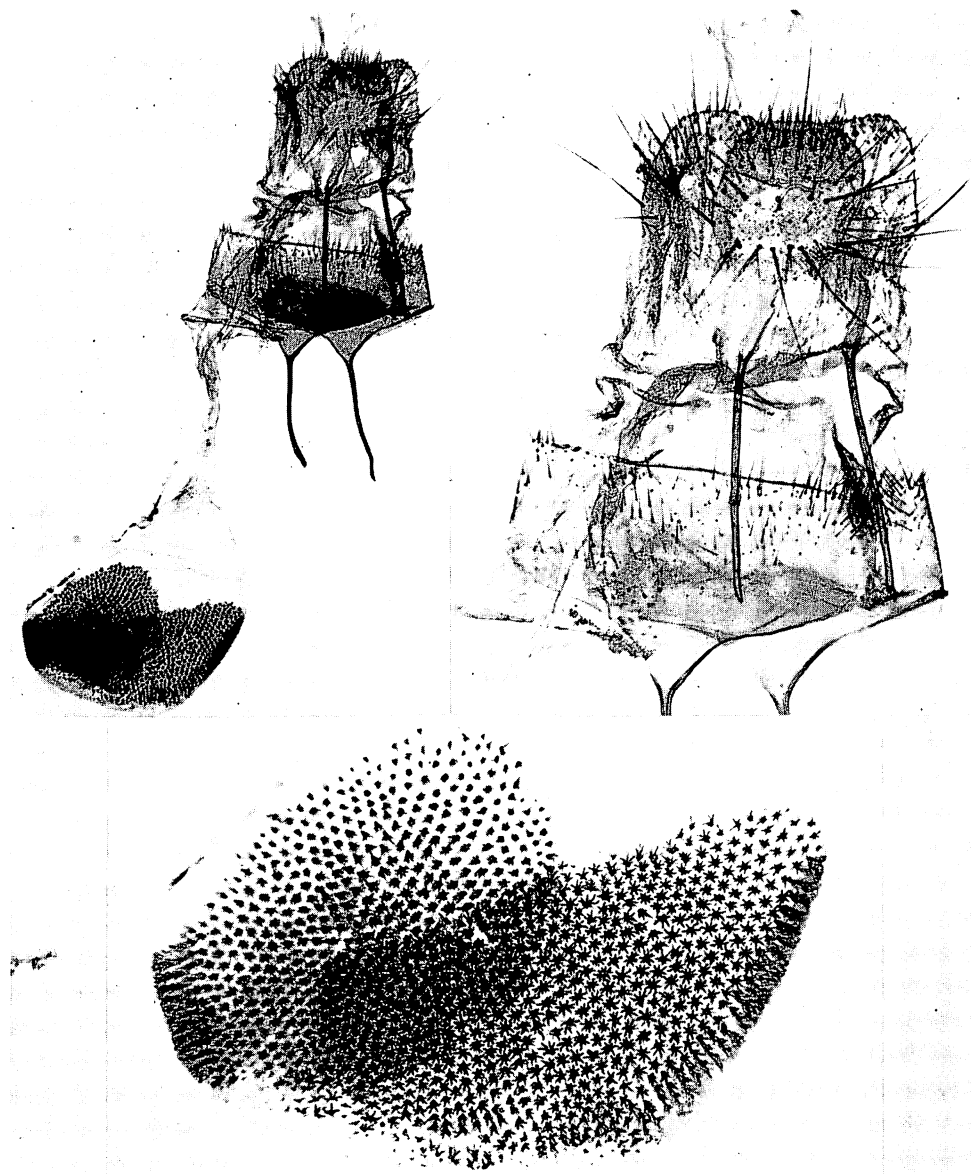


Figure 352—Female genitalia of a paratype of *Hypena senicula* (Meyrick), Kauai.

*Hyphenodes* Doubleday, 1850:cv. (*Hyphenodes* Guenée, manuscript. Several authors have credited Guenée with this genus, but Doubleday described it and is its author.) Neave gives the date of Doubleday's work as 1854, but that is in error. Type: *Hyphenodes humidalis* Doubleday, 1850:cv, the only included species, described from "the bogs of Ireland." *Hyphenodes humidalis*, however, may be a synonym of *Hypena turfosalis* Wocke, 1850, pl. 5, fig. 17 (name and illustrations of male and female; no description), but, in my opinion, *humidalis*, published in October, is probably earlier than Wocke's paper which was published in the fourth (last) part of *Zeitschrift für Entomologie* for 1850 and may have appeared in December, 1850 (the date of issue of this number of the journal should be accurately determined). Staudinger and Wocke (1871:142) list *turfosalis* in *Tholomiges*, and they place *humidalis* as a synonym of *turfosalis*. They place *albistrigatus* Haworth in *Hyphenodes* and after it state: "(*albistrigatus*)," but *albistrigatus* is a synonym of *Schrankia taenialis* Huebner, the type of *Schrankia* Huebner.

***Schrankia*** Herrich-Schaeffer, 1851:448 (this volume is dated 1845, but page 448 was published in 1851), not Huebner 1825:345. Type: *Hypena turfosalis* Wocke, 1850, pl. 5, fig. 17, the only included species. Herrich-Schaeffer (p. 448) stated that his use of *turfosalis* equalled "Taenialis F.R. [Fischer Edlen von Röslerstamm], hardly Huebner's Taenialis Pyr. 151 which F.R. believes it to be" [translation]. We have been unable to trace any mention of *taenialis* by von Röslerstamm and wonder if Herrich-Schaeffer refers to the use of *taenialis* by von Röslerstamm in letters or on specimens. Walker (1858:70) redescribes *Schrankia* Herrich-Schaeffer (misspelled *Schranckia*) and lists *Hyphenodes humidalis* Doubleday as a synonym of *Schrankia turfosalis* on p. 71.

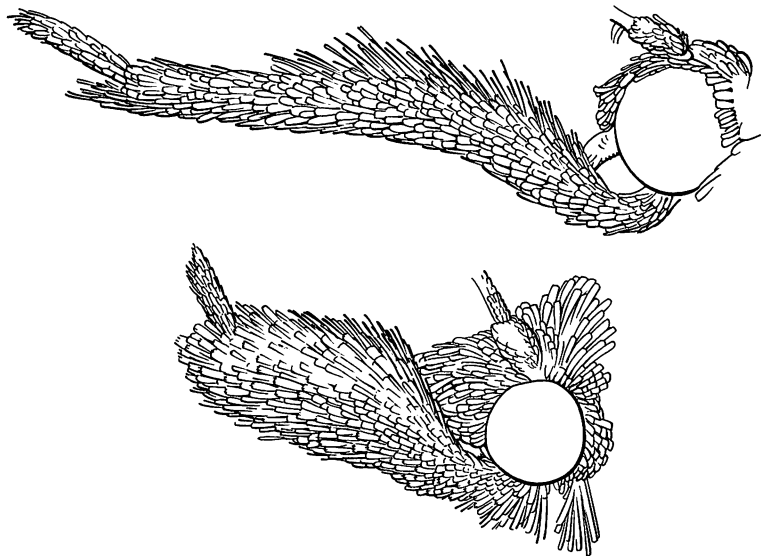


Figure 353—Heads of *Pseudoschrankia epichalca* (Meyrick) (above) and of *Schrankia simplex* (Butler) (below).

**Tholomiges** Lederer, 1857:216. Type: *Schranksia turfosalis* (Wocke, 1850, pl. 5, fig. 17, *Hypena*), the only included species. This genus was erected by Lederer to replace *Schranksia* Herrich-Schaeffer. Staudinger and Wocke (1871:142) list *humidialis* Doubleday as a synonym of *turfosalis* Wocke in *Tholomiges*. Speyer and Speyer (1862:247) give notes on distribution.

The result of this study leads to the following conclusions: *Schranksia* Herrich-Schaeffer, 1851, is a homonym of *Schranksia* Huebner, 1825, and a synonym of *Hyphenodes*. The type of *Schranksia* Herrich-Schaeffer, not Huebner, is the type of *Tholomiges* Lederer, 1857, but this type is also the type of *Hyphenodes* Doubleday, 1850, the earlier generic name, and the two names fall as synonyms of *Hyphenodes*. *Menopsimus* Dyar is a recent synonym of *Hyphenodes*. Thus, it is *Hyphenodes* Doubleday which should be used for the species which are congeneric with *turfosalis*; but it is *Schranksia* Huebner which should be used for the species congeneric with *taenialis*.

In Meyrick's handbook of the British Lepidoptera (1927:164, 165), the use of *Schranksia* and *Hyphenodes* must be reversed.

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The members of this genus rest in a state of confusion in Hawaii; little is known about them, in spite of the fact that a rather large number of specimens have been collected. There may be several additional species to be described from series already assembled, and it is possible that two or several species occur on some islands. The types are not in perfect states of preservation, and this may cause some difficulty. My treatment of the group must be considered as tentative, but I cannot resolve some of the problems without field work.

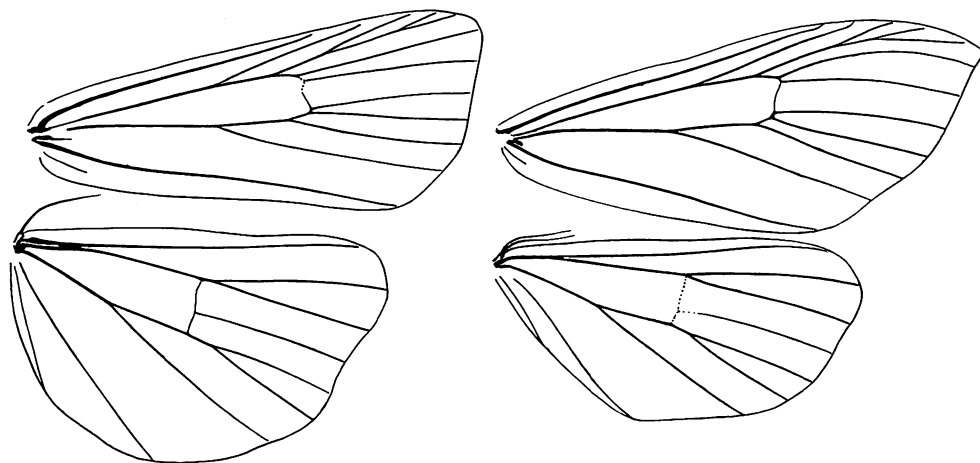


Figure 354—Wing venation of *Schranksia simplex* (Butler) (left) and of *Pseudoschranksia epichalca* (Meyrick) (right).

The habits and hostplants are not fully understood. Perkins (1913:cxlviii) noted that specimens (of *altivolans* and/or *simplex*) "may often be observed in great numbers flying at dusk in marshy places in the mountains amongst sedges." Swezey has reared one of the species from *Paspalum conjugatum* "and other grasses," but no further details are known to me.

Perkins said that these little noctuids were the only native noctuids which came to his sugar-traps on trees in the forests.

#### KEY TO THE HAWAIIAN SCHRANKIA

1. Postmedial line of fore wing very nearly straight (but oblique) from posterior margin to near costa; area outward from antemedial and postmedial lines usually dusted with whitish scales; Kauai. . . **arrhecta** (Meyrick).  
Postmedial line never straight. . . . . 2
- 2 (1). A small Kauai species, type 12 mm. in expanse; postmedial line in fore wing joining costa only a short distance distad of middle of wing. . . **oxygramma** (Meyrick).  
Not so, postmedial line joining costa much nearer apex. . . . 3
- 3 (2). Postmedial line in fore wing orange outlined on either side by black scales, without extensive pale or white scales between this line and the variable and irregular line of white scales between this line and termen (at most with limited white-scaled areas); hairs on under side of antenna of male about twice as long as thickness of an antennal segment. . . . . **simplex** (Butler).  
Postmedial line in fore wing followed distad by extensive pale or white scaling; hairs on under side of antennae of male either short or long. . . . . 4

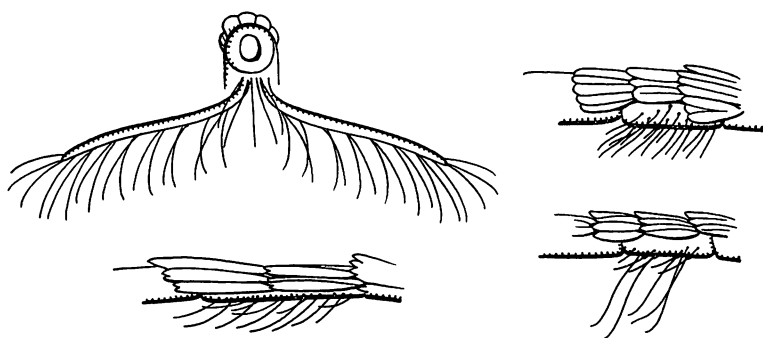


Figure 355—Details of antennae of *Schrankia* and *Pseudoschrankia*. Left top: Cross section of antennal segment of the male type of *Pseudoschrankia epichalca* (Meyrick), and below it a lateral view of some antennal segments of the female of the same species. Right top: Lateral view of some antennal segments of *Schrankia altivolans* (Butler), male, and, below, the same of the male type of *Schrankia simplex* (Butler).

- 4(3). Antennae of male with short hairs beneath, which are hardly as long as the diameter of a segment; Hawaii. . . . . **altivolans** (Butler).  
 Antennae of male with long hairs beneath which are about twice as long as the diameter of a segment. . . . . **sarothrura** (Meyrick).

This key must be taken as tentative. The status of the color patterns of *simplex*, *altivolans* and *sarothrura* and the range of variation is undetermined, and it is possible that forms with the same, or nearly the same patterns may be found in both those with the short-haired and with the long-haired male antennae. Series of reared specimens must be obtained for study.

**Schrankia altivolans** (Butler), **new combination** (figs. 355, 356, 357).

*Scoparia altivolans* Butler, 1880:9, in part.

*Hypenodes altivolans* (Butler) Butler, 1881:325, in part. Meyrick, 1899:155; 1904:347, in part.

Endemic. Kauai ?, Oahu ?, Molokai ?, Maui, Hawaii (type locality: Mauna Loa, 4,000 feet). The distribution of this species remains to be ascertained; it may occur on all the islands. I have carefully examined specimens which I consider are really this species from Maui and Hawaii, and there are other specimens in collections from other islands which may be the same.

Hostplants: *Paspalum conjugatum* and other grasses in the mountains. The caterpillar is said to be a slender, green, "measuring worm" (record applies to this species?).

Much confusion exists concerning this species, and most specimens of Hawaiian *Schrankia* in collections will be found under this name. The species was confused from the time of its description. The two specimens of this species and the three examples which Butler referred to as variety *simplex*—the type series in the British Museum—are all faded and misleading specimens. Meyrick lumped over 100 specimens from six islands under this name in his *Fauna Hawaiiensis* report, but more than one species is involved.

The type male and the so-called type "female" under this name represent two species, and they are both males. The male type has the hairs on the under side of the antenna about twice as long as the diameter of the antennal shaft, whereas these hairs on the so-called female are much shorter and hardly as long as the thickness of the shaft. I followed Butler in considering the two specimens opposite sexes until I dissected them and found both examples to be males, and, of course, one could have ascertained the true identity of the sexes by examining the frenulum. Butler used the so-called female as the type and standard of his species, because he compared the male to it and noted that it differed from the female: "The male is less strongly marked than the female, but this may be an individual variation, or even the result of abrasion." As noted above this male is a different

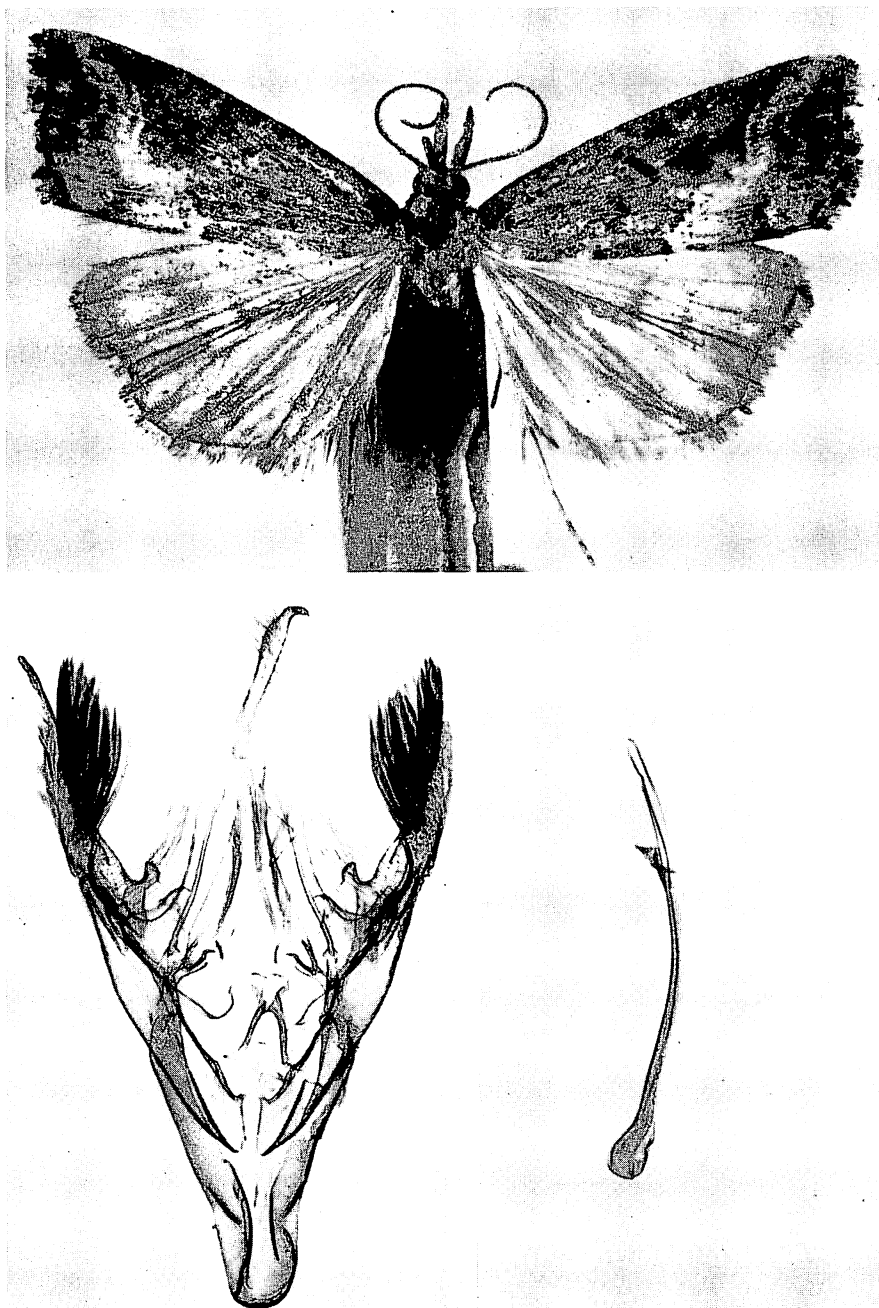


Figure 356—*Schrankia altivolans* (Butler). This male is the so-called "type female" of Butler; expanse, 19 mm.; Blackburn data: "Hawaii 80-31 (97)." The genitalia belong to this specimen; the slender tip of the right valve is broken off.

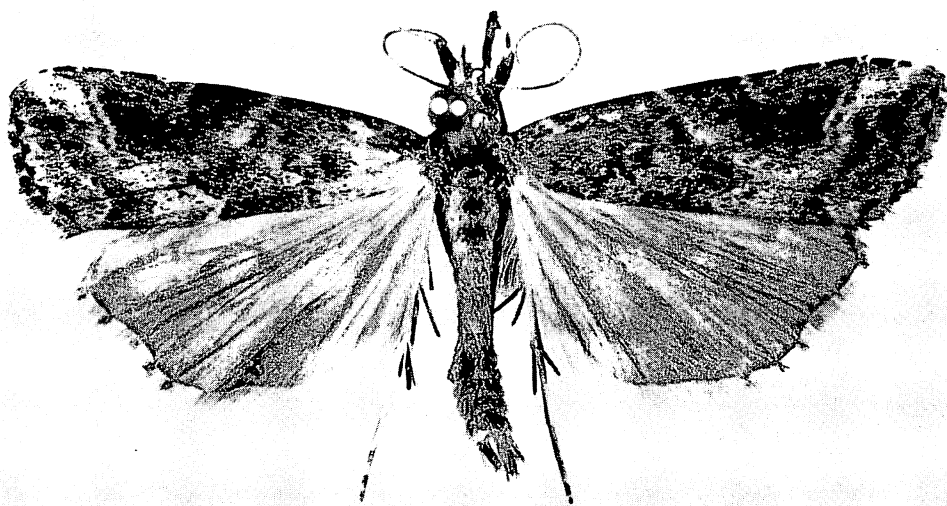


Figure 357—*Schrankia altivolans* (Butler), male; Haleakala, Maui, 5,000 feet; expanse, 22 mm. Details of the antenna of this specimen are shown in figure 355.

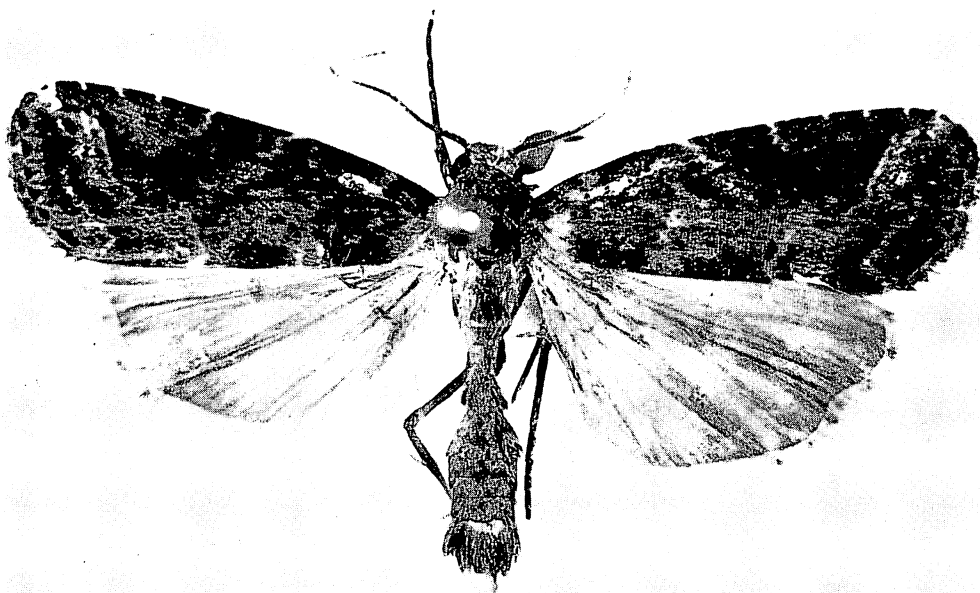


Figure 358—*Schrankia simplex* (Butler), male; northwestern Koolau Mts., Oahu; expanse, 20 mm.

species, and I have found that it is a male of Butler's so-called variety *simplex*. Therefore, the name *altivolans* is now restricted to apply to the species with the short hairs on the under side of the antennae of the male which is represented by the so-called female type of Butler, and Butler's male type is transferred to *simplex*.

This is an extremely variable species, and its true limits are not known. It must be studied in connection with the closely similar form *simplex*, and *sarothrura* must also be taken into account.

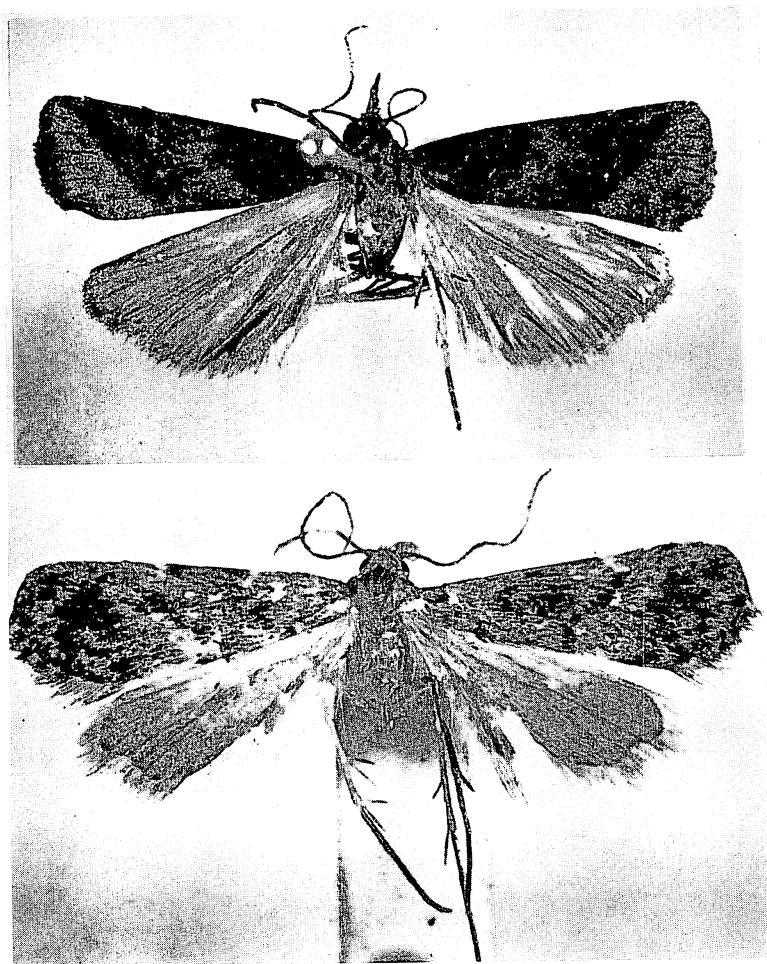


Figure 359—Above: *Schrankia arrhecta* (Meyrick), lectotype female; Kauai, 4,000 feet; expanse, 18 mm. Below: The female type of *Schrankia oxygramma* (Meyrick); Kaholuamano, Kauai; expanse, 12 mm.



**Shrankia arrhecta** (Meyrick), **new combination** (fig. 359).

*Hyphenodes arrhecta* Meyrick, 1904:347.

Endemic. Kauai (type locality: Waimea Mountains, 4,000 feet).

Hostplant: Unknown.

The antennae of the one male in the British Museum have long hairs beneath which are about twice as long as the thickness of the antennal shaft. Unfortunately, this one available male has no abdomen, and I am unable to report upon the genitalia.

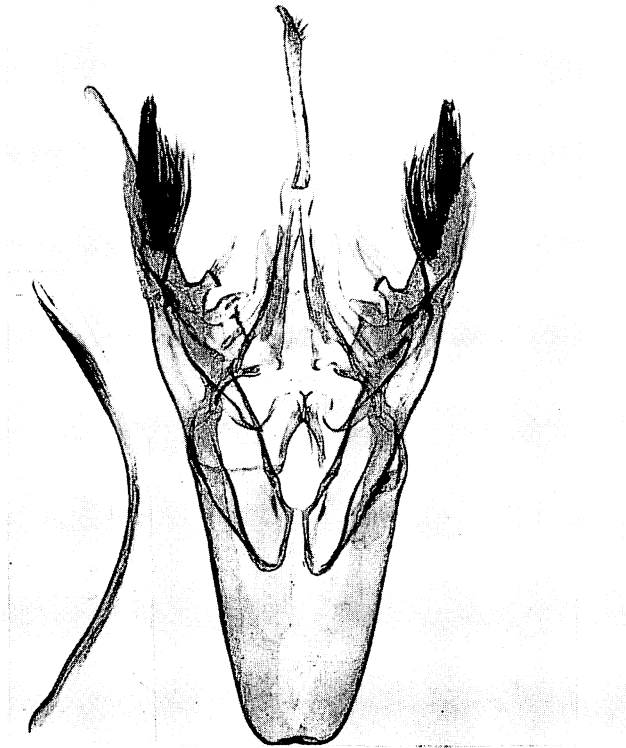
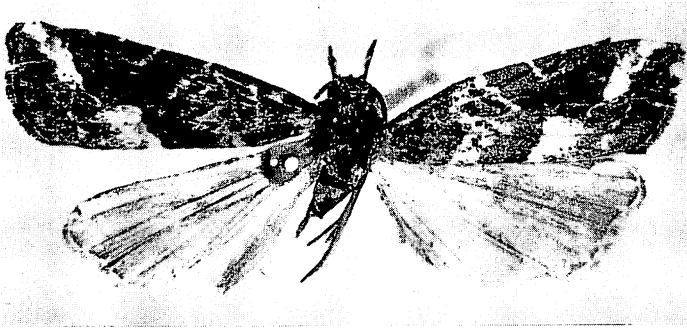


Figure 360—*Shrankia sarothrura* (Meyrick), the male type and its genitalia; Olaa, Hawaii; expanse, 19 mm. The apex of the right valve is broken.

Meyrick did not label a type. I have selected a female, which had its abdomen intact, to be the lectotype in the British Museum, and I have so labeled it. It bears a handwritten label "Kauai 4,000 ft. P./96."

This species is the easiest of the group in Hawaii to recognize, because it has such a straight postmedial line in the fore wing.

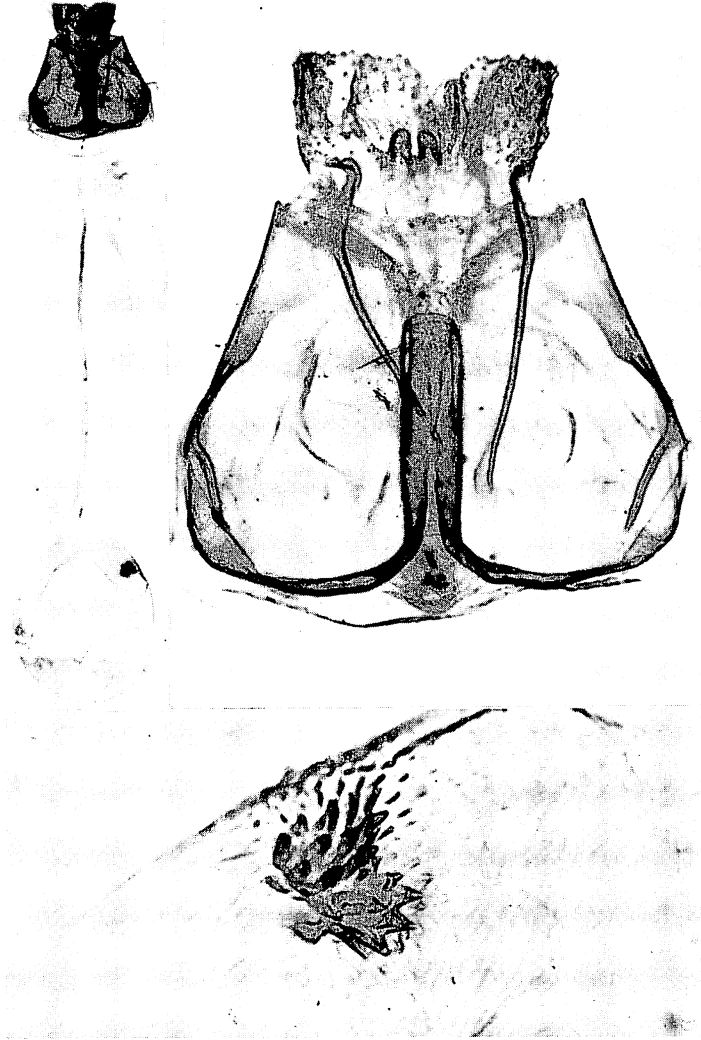


Figure 361—Female genitalia of *Schrankia simplex* (Butler), Oahu. The female genitalia in this genus differ greatly from those of all others in Hawaii. The dark, medial, sclerotized area (in the upper right figure) is a comparatively stiff, tube-like structure, articulated at the base, but otherwise free.

**Schrankia oxygramma** (Meyrick), **new combination** (fig. 359).*Hyphenodes oxygramma* Meyrick, 1899:154, pl. 4, fig. 14.

Endemic. Kauai (type locality: Kaholuamano).

Hostplant: Unknown.

The unique female holotype is imperfect, and little can be said about the species at this time. I have seen only one other example of the genus as small as the type (12 mm.), but the status of this supposed species is uncertain.

**Schrankia sarothrura** (Meyrick), **new combination** (fig. 360).*Hyphenodes sarothrura* Meyrick, 1899:155; 1904:347.

Endemic. Maui, Hawaii (type locality: Olaa).

Hostplant: Unknown.

Meyrick recorded this species from Oahu in 1904, and in his personal collection he also had a specimen from Kauai under this heading. Until a detailed study of this genus can be made, I prefer to restrict the localities of this species to Hawaii and Maui. This form wants careful study with *simplex*. It is closely similar to *simplex* and *altivolans*, and it has long hairs on the under sides of the antennae as does *simplex*.

**Schrankia simplex** (Butler), **new status, new combination** (figs. 353, 354, 355, 357, 361).*Hyphenodes altivolans* variety *simplex* Butler, 1881:325.

Endemic. Kauai ?, Oahu (type locality), Molokai, Maui, Hawaii.

Hostplants: The record listed under *altivolans* of "*Paspalum conjugatum*, and other grasses in the mountains" may apply to this species or equally to each.

Butler's type series (now badly faded and misleading) in the British Museum consists of three examples, two females and one male. The abdomens of the male and one female are missing, and the abdomen of the second female is glued on and may not belong to that individual. The male and one of the females bear the label "Hawaiian Islands 81-7," on the under side of which is written "Hyphenodes simplex Butler." The second female, in addition to the "81-7" label, has written below the "81-7" the number "65," and on the under side the word "type" follows "Butler," but in addition, the type bears a small ticket bearing the two parallel lines which Blackburn used as a code to denote Oahu. Butler stated that *altivolans* came from "Mauna Loa, Hawaii, 4,000 feet above the sea," but no mention was made of the type locality of *simplex*. The type of *altivolans* does not bear a Blackburn code label as does the type of *simplex*. Butler considered the smaller of his three examples ("8 lines" as compared to "9.5 lines" for the type) to represent a variety. He said of the species "Three specimens. 'It occurs all over the Hawaiian archipelago, but I have not observed it to be common.' (T. [homas] B. [lackburn])."

The series examined displays confusing color and pattern variability, and it appears that some specimens with the color pattern typical of this species have the short hair on the under sides of the male antennae as does typical *altivolans*. Such examples may represent another species in this complex.

Although the male genitalia are complex organs, little differences have been found in them. It would appear that they should be expected to display excellent specific characters, but such, disappointingly, is not the case. Moreover, a considerable amount of individual variation has been found in the genitalia of both sexes, and this further compounds the confusion. This group appears to be yet another which is in the process of variation and species formation and clear-cut cleavage is not yet established.

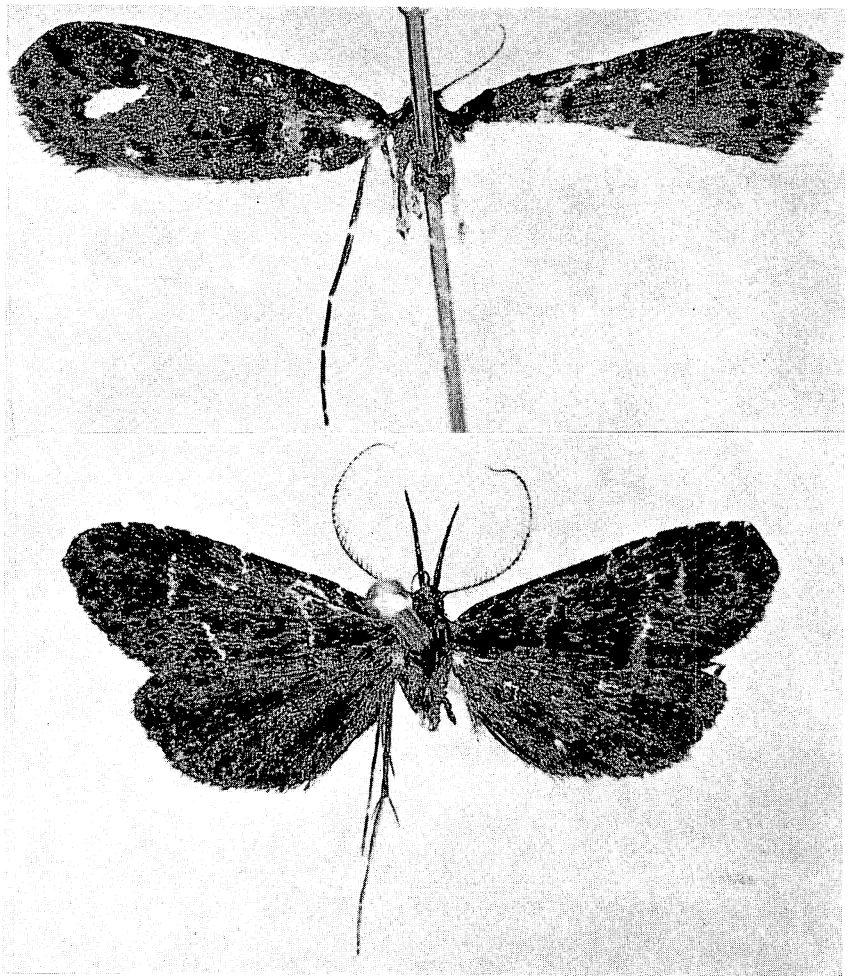


Figure 362—Above: The remaining fragments of the female type of *Pseudoschrunkia cyanias* (Meyrick); Olaa, Hawaii; expanse, 23.5 mm. Below: The male type of *Pseudoschrunkia leptoxantha* (Meyrick); Molokai, 4,500 feet; expanse, 18 mm.; genitalia in figure 364.

Genus **PSEUDOSCHRANKIA**, new genus

Small noctuids, the known species less than 25 mm. in expanse. Ocelli small, somewhat less strongly developed on the single female seen (*epichalca*) than on the males examined. Proboscis long and well developed. Labial palpi as illustrated, very long, more than four times as long as the diameter of an eye, porrect, blade-like, terminal segment small and slender, less than one-fourth as long as penultimate segment. Head with front clothed with long, broad, imbricated scales. Antennae of male strongly and conspicuously bipectinate, the pectinations each with numerous long hairs beneath, the pectinations longest before middle of antennae, the longest pectinations about three-fourths as long as the diameter of an eye, thence becoming progressively shorter so that the apical part of the antenna is not pectinate; antennae of female not pectinate, but with fine hairs beneath which are about as long as the breadth of a segment before the middle of the antennae. Wing shape and venation as illustrated. Legs similar to *Schrankia*,

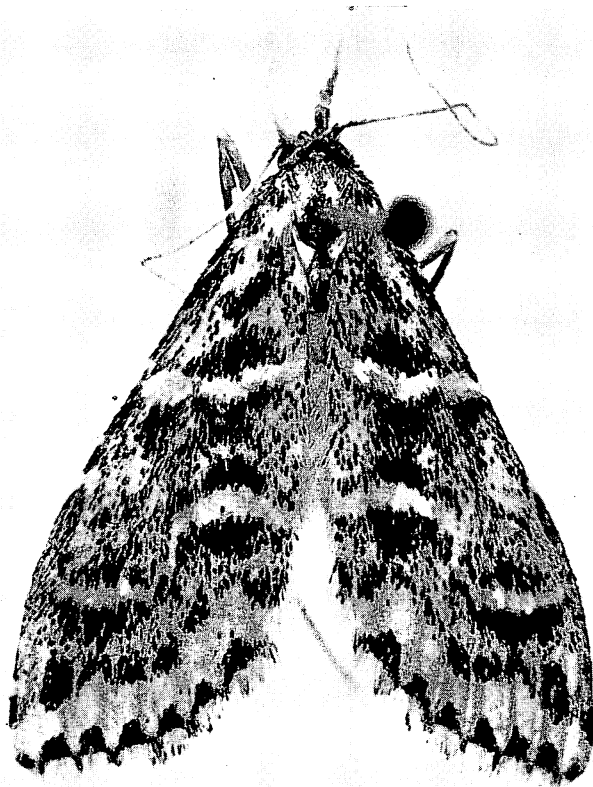


Figure 363—*Pseudoschrankia epichalca* (Meyrick); no field data; fore wing length, 10 mm. The pattern is variable in this striking yellow and black species.

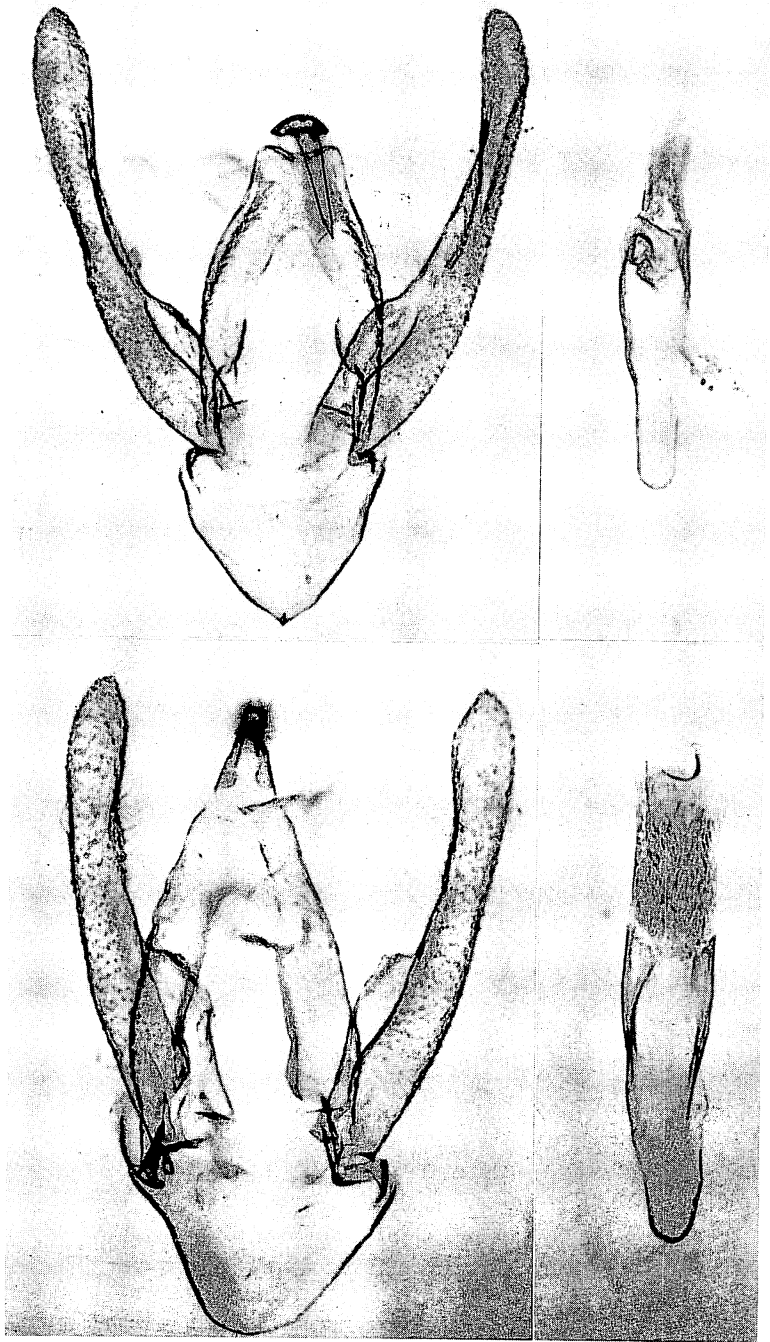


Figure 364—Male genitalia of *Pseudoschrunkia*. Above: The type of *epichalca* (Meyrick); Olaa, Hawaii, 2,000 feet. Below: The type of *leptoxantha* (Meyrick); Molokai, 4,500 feet.

with the spurs similar and the outer spurs shorter than the inner spurs. Genitalia as illustrated.

Type of *Pseudoschrunkia*: *Hyphenodes epichalca* Meyrick. Gender of *Pseudoschrunkia*: feminine.

It is necessary to remove three of the endemic Hawaiian species placed by Meyrick in *Hyphenodes* from association with the other Hawaiian species he assigned to that genus. It has, unfortunately, not been possible to place these species in any genus known to us, and it is necessary to describe a new genus to receive them. The wing venation is like that of the Hawaiian *Schrunkia*, as the drawings illustrate, but the termen is more oblique. The palpi are extraordinarily long. It might at first appear that *Pseudoschrunkia* is a derivative of *Schrunkia* which has developed a different wing shape and more elongate palpi and bipectinate male antennae. However, the male genitalia are much simpler and widely different from the complex genitalia of *Schrunkia*, as the illustrations demonstrate. Also, although the ocelli are small, they are definitely present on *Pseudoschrunkia*, but they are absent on *Schrunkia*. There are no complete female genitalia available for study. The derivation and true relationship of the new genus must await elucidation.

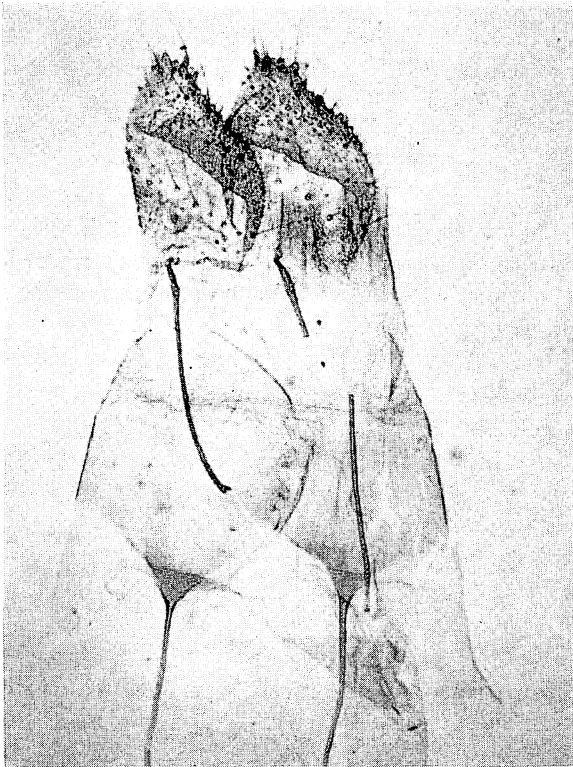


Figure 365—Part of the female genitalia of *Pseudoschrunkia epichalca* (Meyrick); Kilauea, Hawaii. The remainder of the genitalia of this example is not in satisfactory condition for illustration; the abdomen may have been decomposed.

Only four examples are in the British Museum; the male holotype of *leptoxantha*, the fragmentary female holotype of *cyanias*, the male holotype of *epichalca* and a female *epichalca* which lacks the abdomen.

#### KEY TO THE SPECIES OF PSEUDOSCHRANKIA

1. Fore wings bright yellow with strongly contrasting black markings, as illustrated; a very striking species from Hawaii. . . . . ***epichalca*** (Meyrick).  
Dark colored species. . . . . 2
2. Hawaii species; fore wings with patches of brilliant blue and purple scales, with orange-yellow scaling in lines, much paler below than above, with patches of raised scales above (in unique female type); hind wings "light fuscous; a darker discal spot" . . . . . ***cyanias*** (Meyrick).  
Molokai species; fore and hind wings concolorous, very dark, also both pairs of wings are nearly as dark below as above; fore wings with lemon-yellow scaling in lines, without blue scales and without patches of raised scale (in unique male type) . . . . . ***leptoxantha*** (Meyrick).

***Pseudoschranksia cyanias*** (Meyrick), **new combination** (fig. 362).

*Hypenodes cyanias* Meyrick, 1899:154, pl. 4, fig. 13 (error in text says fig. 3).

Endemic. Hawaii (type locality: Olaa).

Hostplant: Unknown.

The unique male holotype in the British Museum is badly broken, and the hind wings and afterbody are missing. The palpi are about 4.6 times as long as an eye.

Dr. Swezey has considered examples collected on Oahu as this species, but they belong to a new species.

***Pseudoschranksia epichalca*** (Meyrick), **new combination**, type of *Pseudoschranksia* (figs. 353, 354, 355, 363, 364, 365).

*Hypenodes epichalca* Meyrick, 1899:154, pl. 4, fig. 12.

Endemic. Hawaii (type locality: Olaa, 2,000 feet).

Hostplant: Unknown.

The black and yellow color pattern of this beautiful species is somewhat variable.

***Pseudoschranksia leptoxantha*** (Meyrick), **new combination** (figs. 362, 364).

*Hypenodes leptoxantha* Meyrick, 1904:130.

Endemic. Molokai (type locality: 4,500 feet).

Hostplant: Unknown.

Only the male holotype is in the British Museum.



## Superfamily SPHINGOIDEA

*Sphingides* Latreille, 1803:320. Leach, 1815:130.

*Sphingidi* Boisduval, 1829:32.

*Sphingoidea* Dyar, 1902. Mosher, 1916:135. Forbes, 1948:176.

## Family SPHINGIDAE (Latreille)

*Sphingides* Latreille, 1803:320. Boisduval, 1840:45.

See Opinion 379, International Commission for Zoological Nomenclature, 1956, regarding the family name.

## Sphinx Moths, Hawk Moths, Hummingbird Moths

The classic work on this interesting family is the world monograph by Rothschild and Jordan (1903) to which the student is referred for extensive discussion. Butler, 1876. For details of pupae and key to some genera, see Mosher (1916: 135, 136).

## KEY TO THE SUBFAMILIES AND GENERA OF SPHINGIDAE IN HAWAII

1. First palpal segment without an area of short setae on the unscaled inner surface near base (the unscaled derm is distinctly bare of any short setae) (**Asemanophorae, Sphinginae**) ..... 2
- First palpal segment with an area or mat of short, dense setae on the unscaled area near base on inner side (the area may be extensively short-setose, and the setae easily overlooked unless examined carefully) (**Semanophorae**) ..... 3

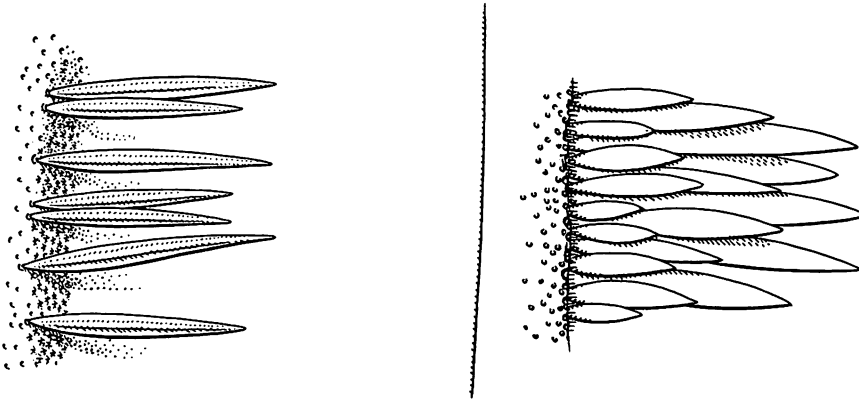


Figure 366—Specialized, persistent, spines or scales on the abdominal segments of two sphingids; these structures are usually hidden by the scales or hairs, which must be removed to expose them. Left: Spines on the underside of an abdominal segment of *Herse cingulata* (Fabricius). The vertical line far to the right of the apices of the spines is the apex of the abdominal segment. Note how far away it is. Right: Spines on the venter of an abdominal segment of *Celerio wilsoni* (Rothschild). Note that the apex of the abdominal segment is at the base of the spines in this species, and compare *Herse*.

- 2(1). Abdomen with pink spots; second palpal segment with a large, outstanding, subapical fovea on inner side enclosed by scales. . . . . **Herse.**  
 Abdomen with yellow spots; inner side of second palpal segment without such a fovea. . . . . **Phlegethontius.**
- 3(1). Our species with extensive green scaling; palpi rising distinctly above level of base of antenna; abdominal spines replaced by long, very slender scales situated along a preapical line (**Philampelinae**) . . . **Tinostoma.**  
 Our species without any green scaling, but with some pink or orange scaling; palpi not rising to level of top of eyes; abdominal setae well developed, very numerous and dense and consisting of several rows of stiff, flattened, imbricated scales along the apical margins of the segments (**Chaerocampinae**) . . . . . **Celerio.**

The caterpillars of sphingids are commonly known as hornworms because of the long subcaudal dorsal process, or "horn." I regret that, at this writing, there is not available a complete enough collection of larvae and pupae to make it possible to draft a set of complete keys. The larvae and pupae of *Tinostoma* and some of the *Celerio* are unknown, but a simplified key to some of the species is given

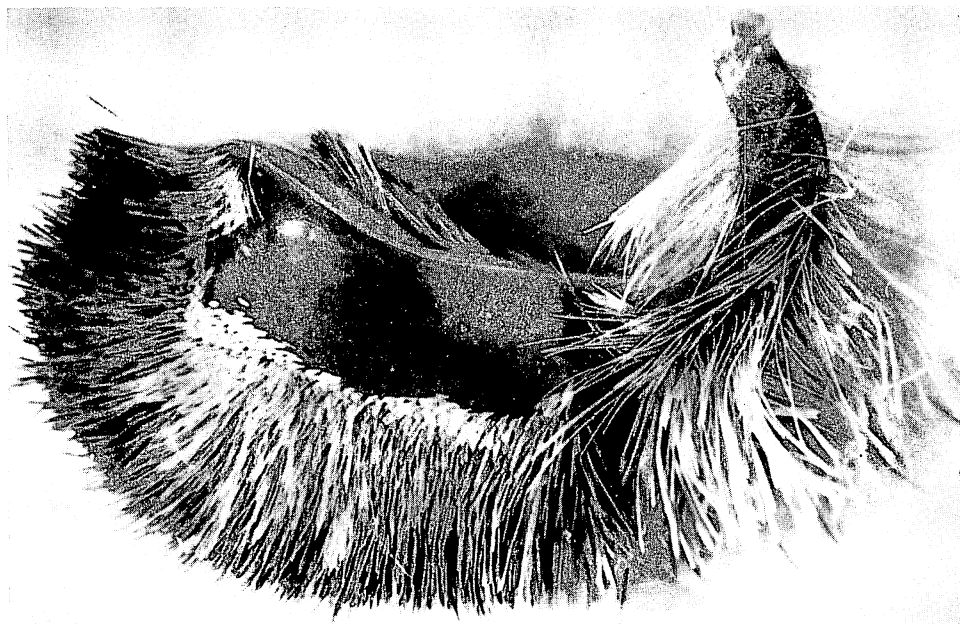


Figure 367—View of inner side of a palpus of *Celerio wilsoni* (Rothschild).

below. The pupae of *Herse* and *Phlegethontius* are easily recognized, because in each the proboscis case is looped away from the body and resembles the handle of a jug. The proboscis case of *Herse* is recoiled, whereas that of *Phlegethontius* makes a simple and continuous arch, as the figures demonstrate. The proboscis case on the pupa of *Celerio*, however, does not form a loop, but it adheres closely to the sternum for its entire length.

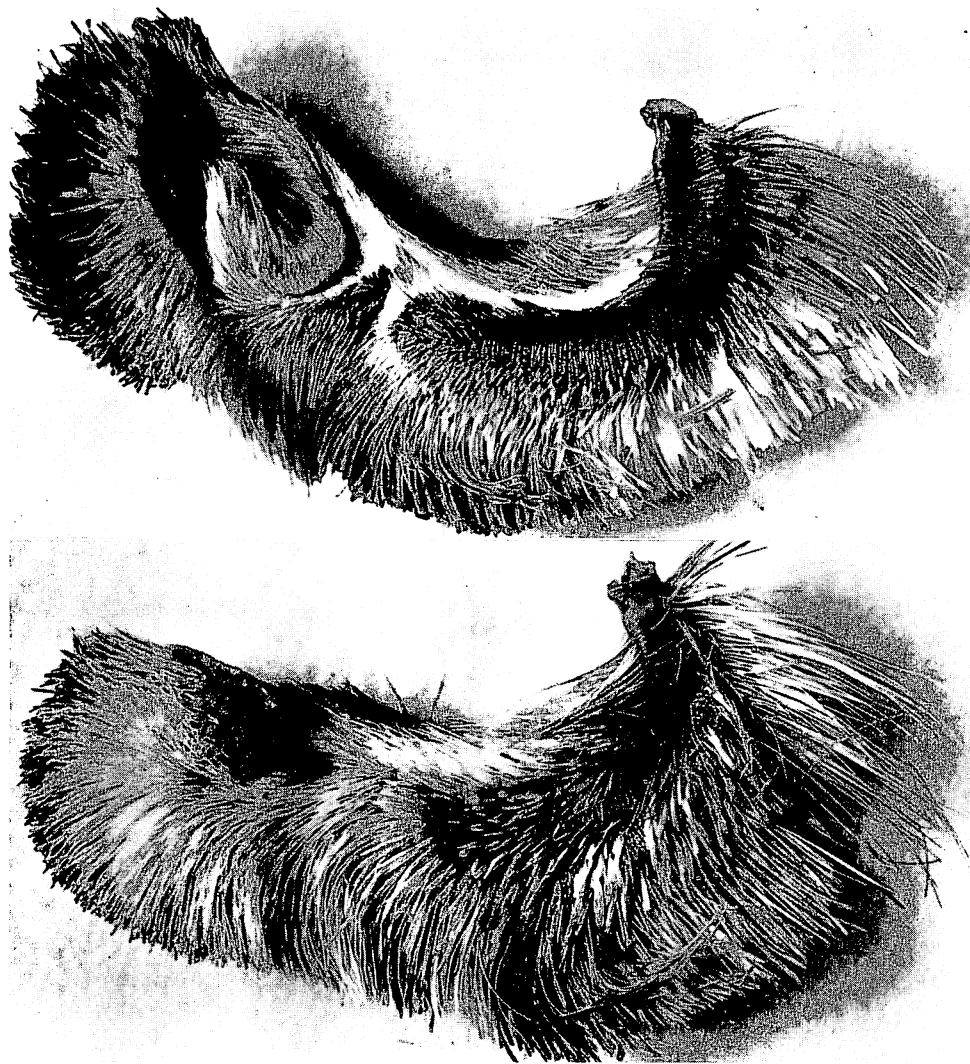


Figure 368—View of the inner side of a palpus of *Herse cingulata* (Fabricius) (above) and of *Phlegethontius quinquemaculatus* (Haworth) (below).

## SIMPLIFIED KEY TO THE LARVAE OF SOME SPHINGIDAE

1. Caterpillars on endemic shrubs or trees. . . . . endemic species of **Celerio**.  
 Caterpillars on low herbage (or *Nicotiana glauca*), mostly  
 not native plants. . . . . 2
2. On *Portulaca*, *Boerhaavia*, *Fuchsia*, *Godetia* or *Xanthium*;  
 body yellowish with large black spots on dorsum; pro-  
 thoracic shield brownish-yellow dotted with white. . . . .  
 . . . . . **Celerio lineata** (Fabricius).  
 Not so; sides of body with oblique lines slanting upward and  
 backward. . . . . 3
3. Commonly on sweetpotato and *Ipomoea* species; spiracles  
 surrounded by dark color; oblique lines on sides of body  
 dark; front of head with two pairs of dark vertical lines;  
 mesonotum and metanotum with dark or black spots. . . . .  
 . . . . . **Herse cingulata** (Fabricius).  
 Commonly on *Nicotiana*, tomato, eggplant and *Solanum*;  
 spiracles surrounded by pale rings; oblique lines on sides  
 of body pale; front of head with one pair of dark vertical  
 lines; mesonotum and metanotum sprinkled with pale or  
 white spots. . . . . **Phlegethontius**.

Subfamily PHILAMPELINAE (Burmeister) Rothschild and Jordan, 1903:475.

The name of this subfamily may require revision; see Rothschild and Jordan (1903:475) for synonymy.

Tribe PHILAMPELINI (Rothschild and Jordan)

*Philampelicae* Rothschild and Jordan, 1903:475.

Genus **TINOSTOMA** Rothschild and Jordan, 1903:L, cxiv, cxxxiv, 347, 475, 497.

This genus was proposed to receive the following species, and it remains monotypic. Rothschild and Jordan stated that it shares with *Cressonia* (from North America) the distinction of having the longest and most slender palpi in the Sphingidae. *Tinostoma* and the American *Pholus* are the only genera included in the Philampelini.

***Tinostoma smaragditi*** (Meyrick) (figs. 370, 371).

*Deilephila* (?) *smaragditi* Meyrick, 1899:191, pl. 5, fig. 7.

*Tinostoma smaragditi* (Meyrick) Rothschild and Jordan, 1903:498.

Endemic ? Kauai (type locality: Makaweli, 2,000 feet).

Hostplant: Unknown.

This species is known as "The Fabulous Green Sphinx of Kauai" or "The Elusive Green Sphinx of Kauai." It is an enigma. It is known only from the holotype in the British Museum which bears the following label in Perkins' handwriting: "Makaweli K. 2,000 ft. given me V-95 by the ladies of the Gay family. Caught some years before." Special searching by several entomologists has failed to rediscover the species.

The late B. Preston Clark, of Boston, who had all but a few of the world's known Sphingidae in his extensive collection, for long had a standing offer of one hundred dollars for a specimen of this moth. In 1919, Mr. Clark sent August Kuschel on a special expedition to Kauai to search for it. Kuschel spent from January to April, 1919, searching in the area from Kokee to Kaholuamano without

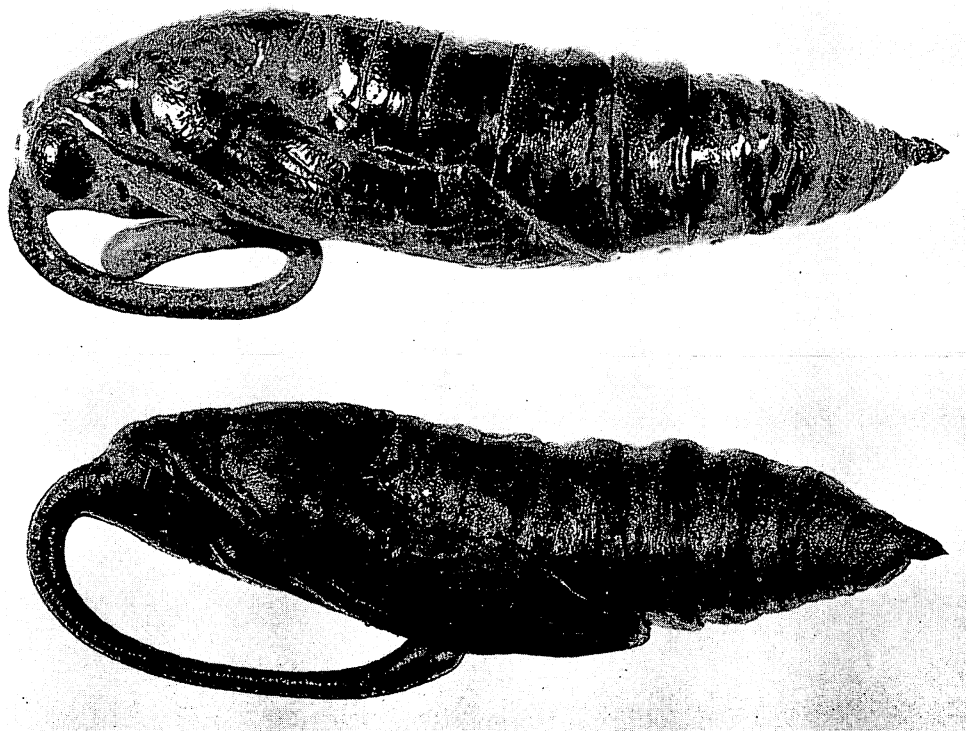


Figure 369—Pupa of *Herse cingulata* (Fabricius); length, 51 mm. (above), and of *Phlegethontius quinquemaculatus* (Haworth), length, 65 mm. (below).

collecting the moth. He returned to the area in August and September, and renewed the search in April of 1920. No green sphinx were found. Kutsche reported that, during August and September, he had reared 22 caterpillars which he considered to be those of the green sphinx. He said that he had found the caterpillars on *Lysimachia hillebrandi*. However, Kutsche never produced an adult. He was recalled to California by illness in the family, and he reportedly left the pupae on Kauai because he thought that "bringing them down from the high altitudes would kill them." He also confided in local entomologists that he had seen the moths flying about *Metrosideros* trees, but that they were always too high for him to capture. Kutsche was not known for his veracity, and all of his reports may have been a hoax. We know, for example, that he labelled a lot of Kauai insects as having been collected by him on the privately-owned, difficult-to-get-to island of Niihau. Kutsche never got to the island of Niihau, although he claimed that he did and stated that he collected many insects there which we know are confined to the highlands of Kauai. Therefore, little reliance can be placed upon Kutsche's reports, and I doubt very much if he ever saw the green sphinx or discovered any caterpillars of it.

Perkins (1913:cliii), speaking of the native sphingids, said, "No representative of these has yet been taken on Kauai, but caterpillars similar to those of the others have frequently been found there, so that at least one additional species is to be expected, unless these caterpillars prove to belong to the remarkable green-coloured *D. smaragdita*." We now know, however, that the endemic *Celerio calida* occurs on Kauai, and the caterpillars mentioned by Perkins probably were of this latter species.

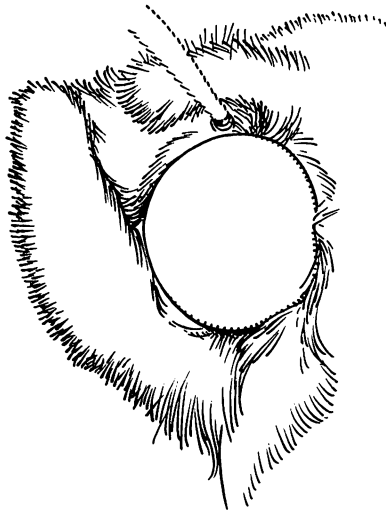


Figure 370—Head of *Tinostoma smaragdita* (Meyrick).

I am not satisfied that this moth is Hawaiian, although it is possible that it might be a native. As noted above, the type was given to Dr. Perkins by the Gay family. There was a naturalist Gay in Chile. Could it be that a relative of the family sent the moth to Kauai? There is, too, the possibility of a pupa having been accidentally imported in a box or parcel which was carried to the mountain house where the moth emerged. I asked Dr. Perkins about these possibilities when I visited him in England in 1949, but he said that the moth had been captured alive in the mountain house of the Gay family and that they had reported seeing more of the moths.

The green coloring of the fore wings and the coloration of the abdomen strongly suggest *Pholus labruscae* (Linnaeus), which ranges from South America to Canada. The subapical "spines" of the abdominal segments are also similar to *Pholus*. It is true that the moth is a most distinctive species representing what is evidently a distinct genus, and its relationships are American. The only way to solve the questions regarding it is to discover additional specimens and ascertain its native land.

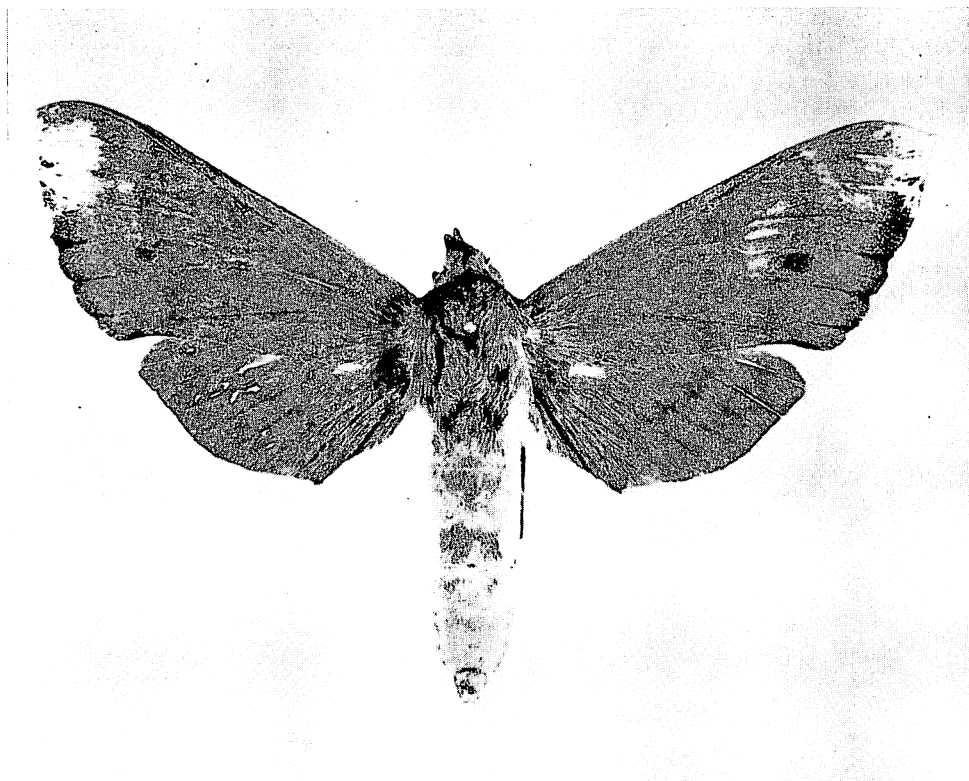


Figure 371—The unique type of *Tinostoma smaragdilis* (Meyrick); expanse, 87 mm.; Makaweli, Kauai, 2,000 feet. This photograph does not indicate the differences in color between the fore and hind wings. The fore wings are green with a black spot and dark brown apical margins; the apices of the wings are rubbed. The hind wings are brown with nearly white fringe, which has disappeared in the photograph. The darker shades on the abdomen indicate green hairs and scales, and the background color of the dorsum of the abdomen is orange.

## Subfamily CHAEROCAMPINAE Butler

*Chaerocampinae* Butler, 1876:516.

*Choerocampinae* (Butler) Rothschild and Jordan, 1903:672.

*Celerianae* Hampson, 1918:384.

Genus **CELERIO** Oken

*Celerio* Oken, 1815; type: *Sphinx gallii* Rottenburg.

*Hawaiiina* Tutt, 1903:76; 1904:137; type *Deilephila calida* Butler. **New synonym.**

*Hawaiiiana*, misspelling by Swezey, *Proc. Hawaiian Ent. Soc.* 12 (1):22, 1944.

Tutt said that Kaye (*in litteris*) gave him the following characters for *Hawaiiina* (type *calida*): "Antennae very long and very stout in ♂; forewings very dark; hindwings deep orange, with dark border reaching margin." I do not consider this adequate reason for erecting a genus for the Hawaiian *Celerio*, and I consider *Hawaiiina* untenable as based upon the suggestions of Kaye and Tutt.

The endemic Hawaiian *Celerio* are much like the Holarctic *Celerio gallii*, and it is possible that the Hawaiian complex has been derived from a race of that species or a closely similar form.

These moths are often active during the day.

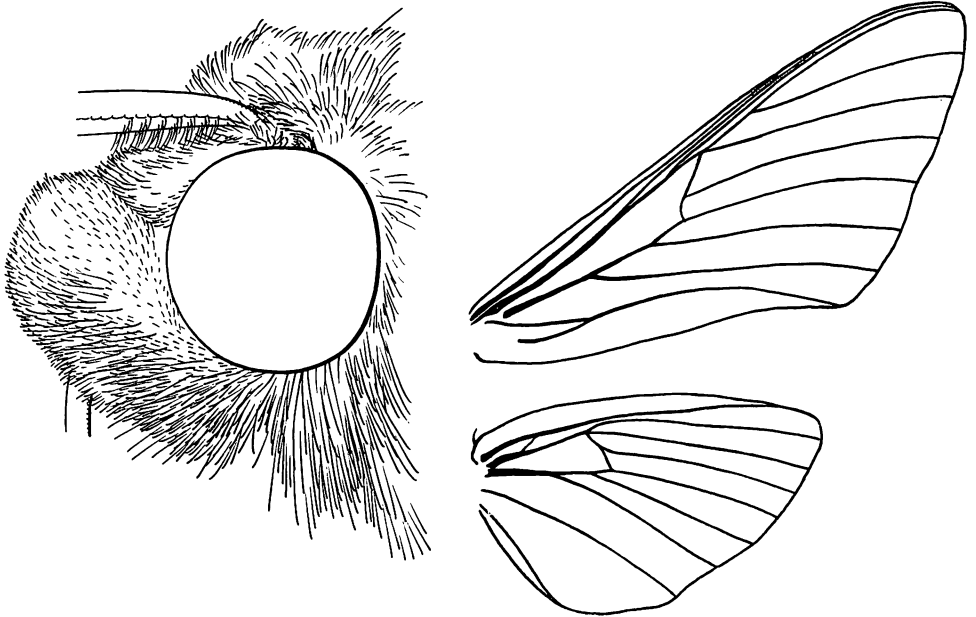


Figure 372—Head of *Celerio wilsoni* (Rothschild) (left) and wing venation of *Celerio lineata* (Fabricius) (right).



1. Fore wing with a striking diagonal pale line from posterior base to apex, and many veins white-scaled and outstanding, as figured. . . . . **lineata lineata** (Fabricius).  
Fore wing without such pale lines. . . . . 2

2(1). Fore wing with the inner edge of the postmedial transverse dark line forming a mostly continuous, sinuous line across wing, but not zigzag. . . . . 3  
Fore wing with the postmedial transverse dark line conspicuously zigzag. . . . . 4

3(2). Anterior dark area on hind wing continuous from base to costa, as figured. . . . . **calida calida** (Butler).  
Anterior dark area on hind wing much abbreviated and well isolated from base of wing, as figured. . . . .  
. . . . . **calida hawaiiensis** Rothschild and Jordan.

4(2). The pale area on hind wing distinctly and broadly reaching the costa, thus obviously separating the dark area into an anterior and posterior dark band, as figured. . . . .  
. . . . . **wilsoni wilsoni** (Rothschild).  
Anterior and posterior dark areas on hind wing continuous or almost continuous around outer margins of wing, thus largely isolating the pale enclosed area from costa, as figured. . . . . **wilsoni perkinsi** (Swezey).

Pale green (belly whitish), sparingly dusted with white; dorsal and spiracular lines whitish, but rather obscure; first segment (i.e. the one behind the head) obscurely suffused with red;

spiracles pink, with a crimson centre; head and legs green; claspers green, tipped with crimson; horn short and warty, black above, red beneath; head small; second and third segments behind the head much distended.

Another individual was as follows:—Greenish grey, with a sooty appearance, sparingly sprinkled with rather large white spots; underside green; dorsal line yellow, very conspicuous; spiracular line white; spiracles yellow, with the centre dull orange; subspiracular line whitish, but very indistinct,

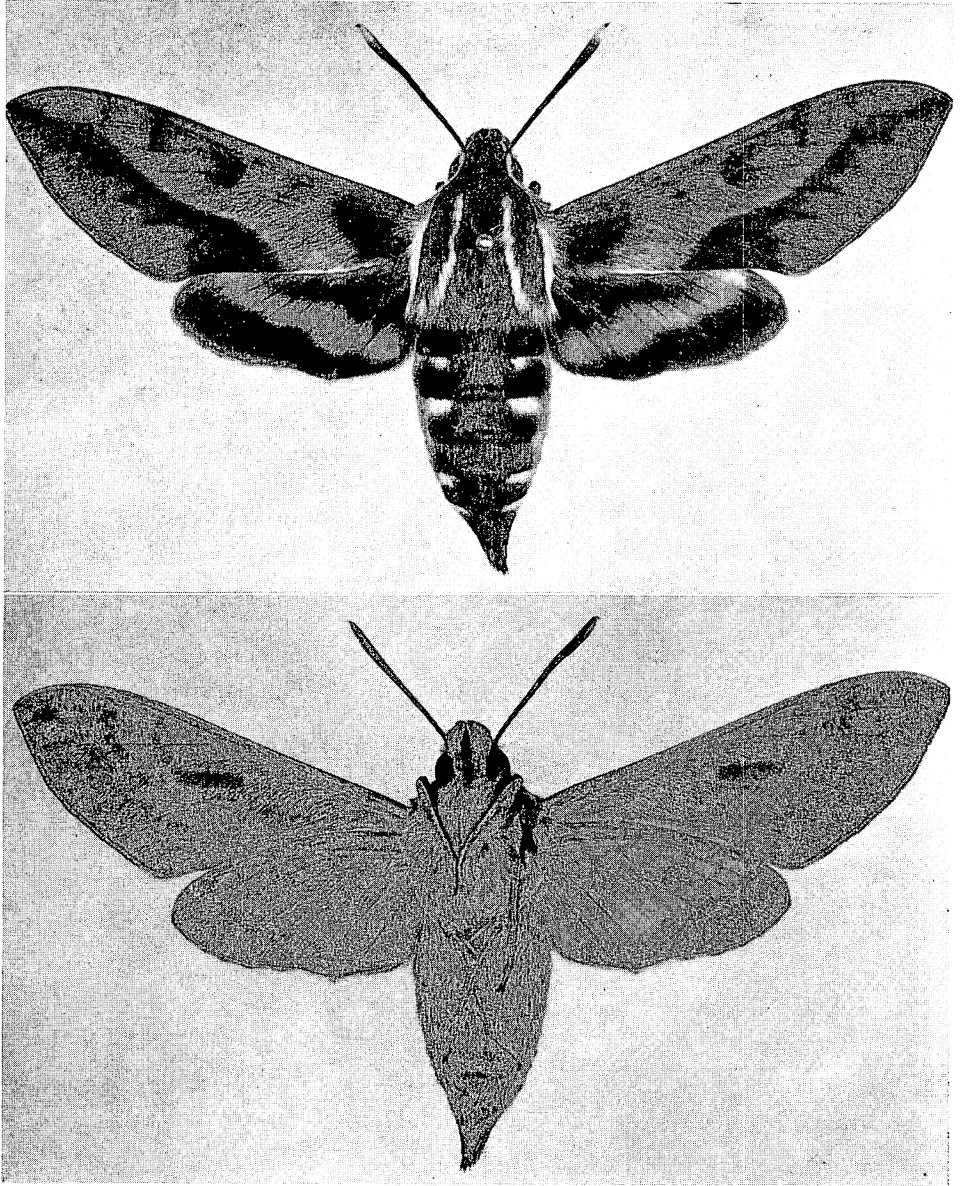


Figure 373—Dorsal and ventral views of *Celerio calida calida* (Butler); Molokai, 1,000 feet; expanse, 65 mm.

excepting on last segment, where it forms a conspicuous white line on either side, converging to the horn. There is a general tendency in this form of the larva to a mauve-coloured suffusion in various parts of the body, which is very conspicuous when the larva is about half-grown.

The two forms of larva described produced identical moths, although, I think, different sexes.

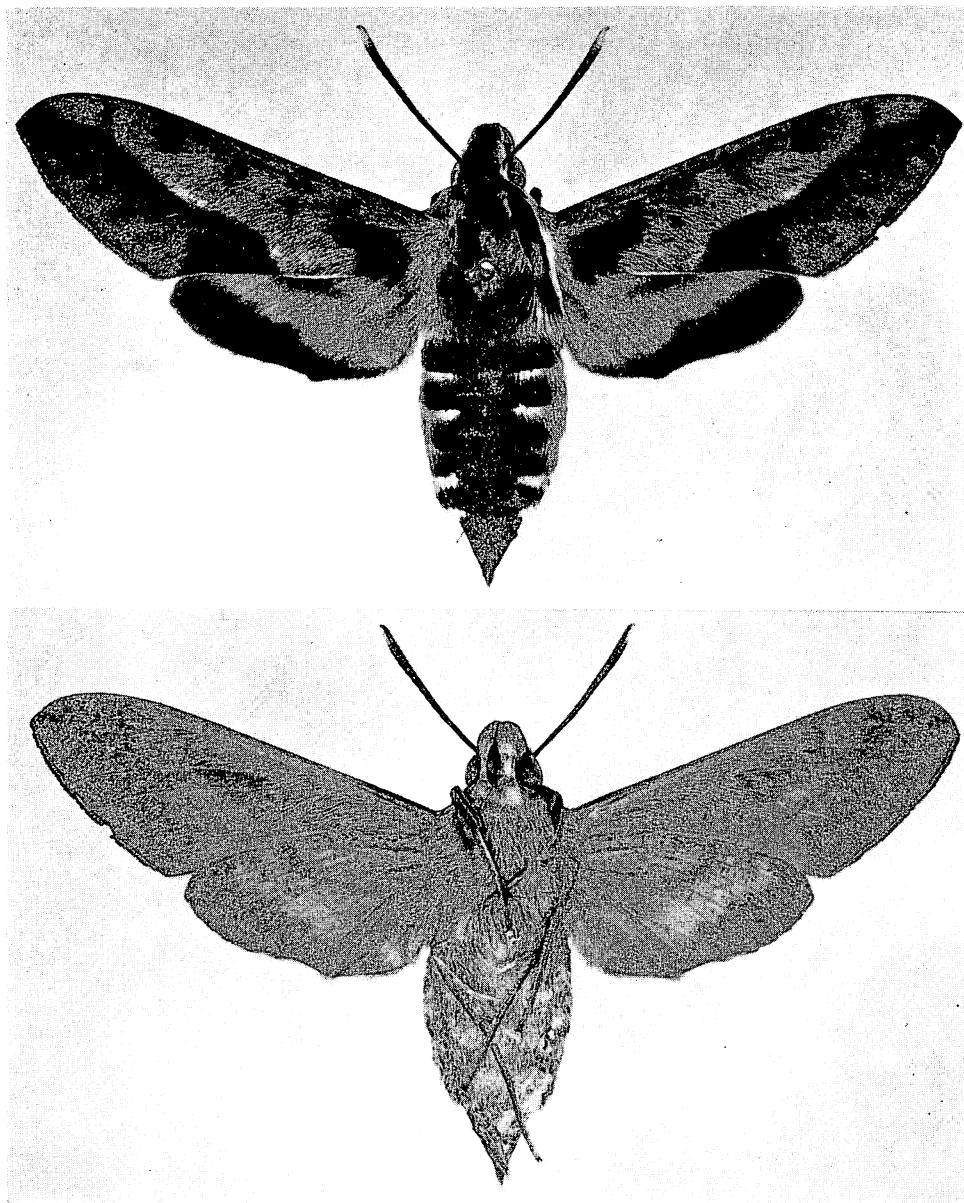


Figure 374—Dorsal and ventral views of a paratype of *Celerio calida hawaiiensis* Rothschild and Jordan; Kau, Hawaii; expanse, 62 mm.

**Celerio calida hawaiiensis** Rothschild and Jordan (fig. 374).

*Celerio calida hawaiiensis* Rothschild and Jordan, 1915:290.

*Deilephila calida*, in part (not of Butler), Rothschild, 1895, pl. 9, fig. 1; misidentified as *calida*. Rothschild and Jordan, 1903:715, in part.

*Hawaiina calida hawaiiensis* (Rothschild and Jordan) Swezey, 1954:37, fig. 10.

Endemic. Hawaii (type locality: Mauna Kea).

Hostplant: Unknown.

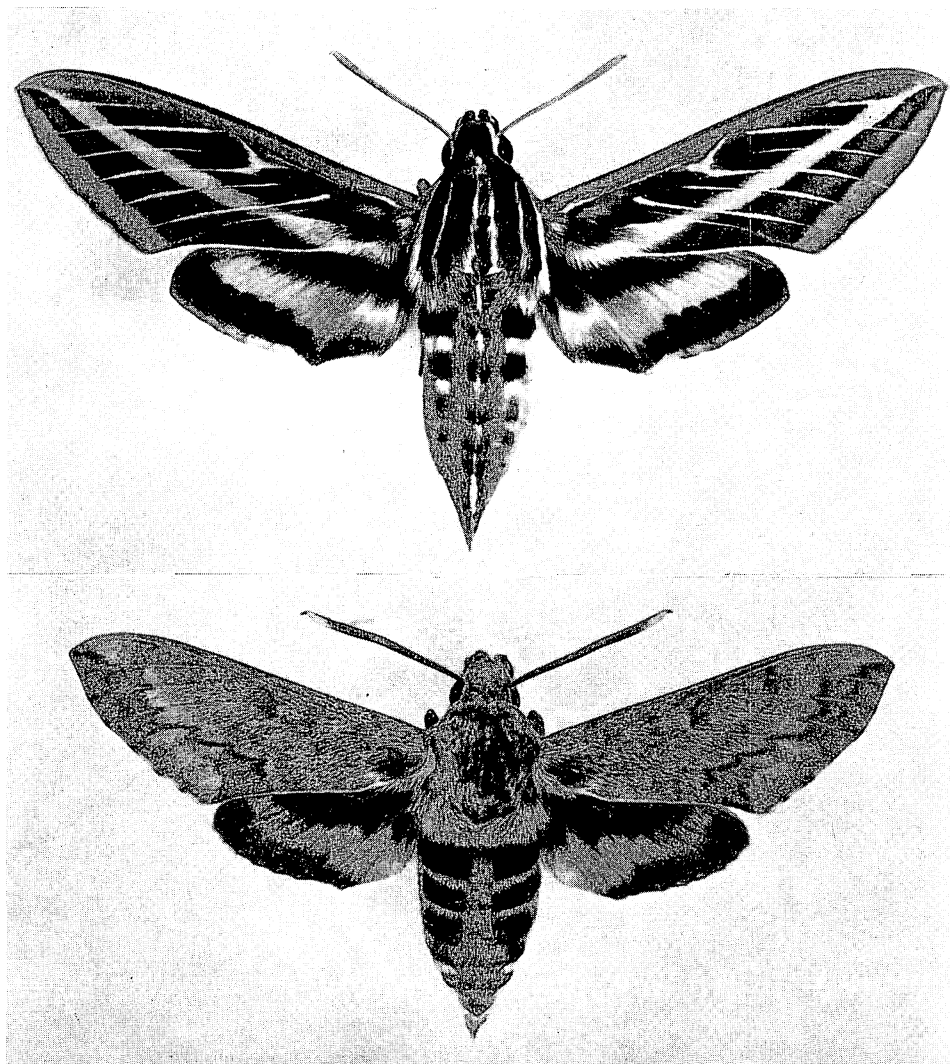


Figure 375—Above: *Celerio lineata* (Fabricius), Waipahu, Oahu. Below: Type of *Celerio wilsoni perkinsi* (Swezey); Mt. Tantalus, Oahu; fore wing length, 26 mm.

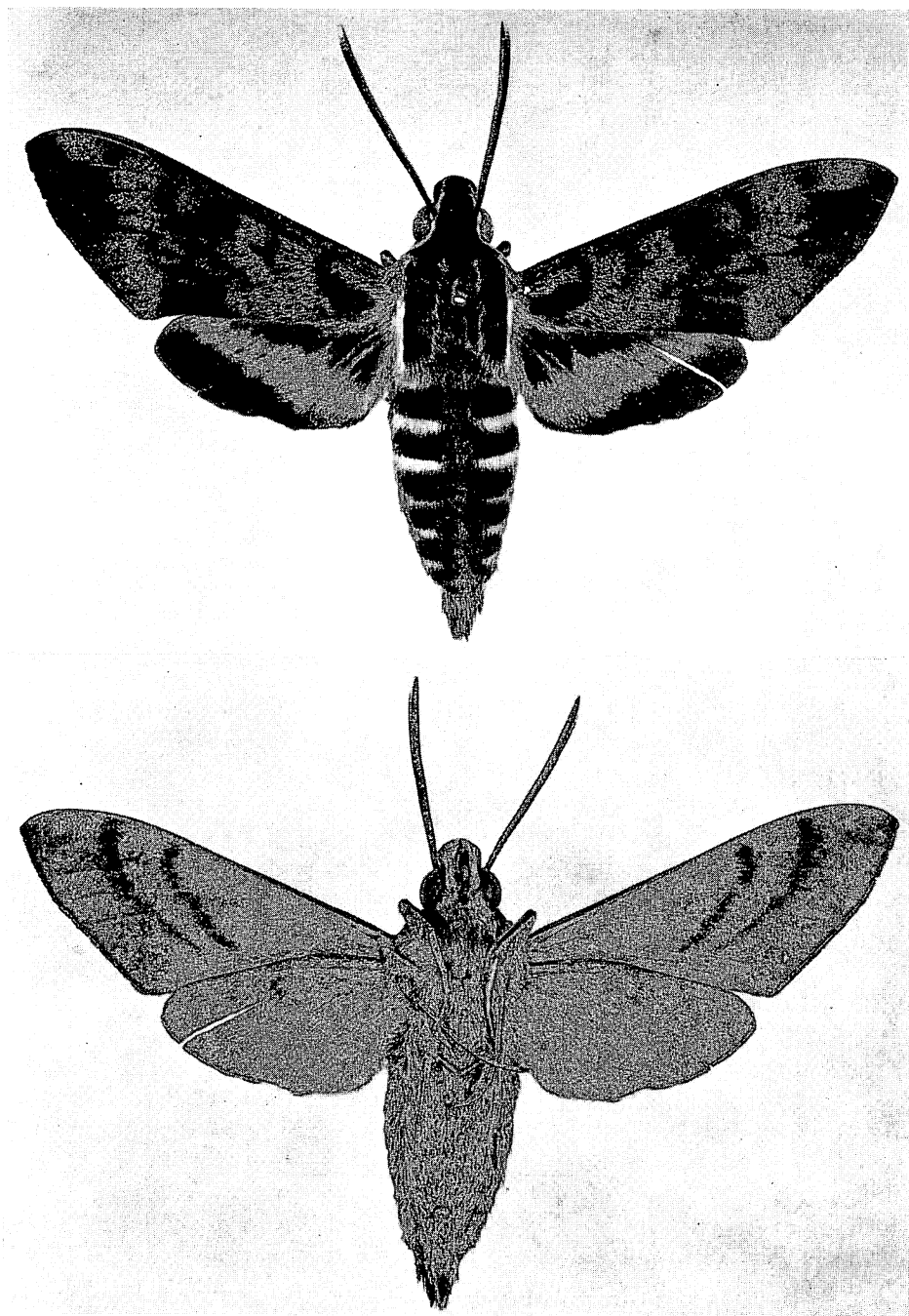


Figure 376—Dorsal and ventral views of *Celerio wilsoni wilsoni* (Rothschild); Olaa, Hawaii, 2,000 feet; expanse, 69 mm.

**Celerio lineata lineata** (Fabricius) (figs. 372, 375).*Sphinx lineata* Fabricius, 1775:541.*Deilephila livornica* Esper, Butler, 1877:47.*Deilephila lineata* (Fabricius), Meyrick, 1899:192.*Celerio lineata* (Fabricius) Rothschild and Jordan, 1903:731.

The white-lined sphinx.

Niihau, Oahu, Molokai, Lanai, Hawaii.

Immigrant; very widespread about the world. First found in Hawaii by Blackburn (Butler, 1877:47).

Hostplants: *Boerhavia*, *Fuchsia*, *Godetia grandiflora*, *Portulaca*, *Xanthium*.Parasites: *Trichogramma minutum* Riley, *Trichogramma semifumatum* (Perkins).

This is a common and widespread moth. When the spring rains bring on the flush growth of *Portulaca*, the caterpillars frequently develop in hordes. See Grant (1937:345-357) for details of outbreaks and migrations in America. In 1926, a "caterpillar plague" struck the Kau, Hawaii, area, and Swezey (*Proc. Hawaiian Ent. Soc.* 6(3):371-372, 1927) reported as follows:

A few caterpillars were sent and they proved to be those of two common hawkmoths: *Celerio lineata* (Fab.) and *Herse cingulata* (Fab.). Apparently rains in the region had brought on a new growth of *Portulaca* and *Ipomoea*, which are the favorite food plants of these species respectively. The caterpillars were very numerous over a large lowland area, extending over nearly all the region from the south point to Honuapo and to Waiohinu. Some families were said to have moved from their houses on account of the numerous caterpillars crawling in.

The moths often fly freely in bright sunshine and are frequently to be seen feeding at the flowers of *Lantana* where it grows near *Portulaca* patches in the lowlands; but the moth also ranges far up into the mountains.

Swezey (1944:141) described the caterpillar as follows: "Body yellowish, with large black segmental spots on dorsum tending to form transverse bands; usually a distinct middorsal longitudinal yellow line or stripe; prothoracic shield brownish yellow, with numerous white dots." For illustrations of larva, see Peterson (1948: 220, figs. L55, L-M).

**Celerio wilsoni wilsoni** (Rothschild) (figs. 366, 367, 372, 376).*Deilephila wilsoni* Rothschild, 1894:83; 1895, pl. 9, fig. 2.*Deilephila pyrias* Meyrick, 1899:191, pl. 5, fig. 8.*Celerio wilsoni* (Rothschild) Rothschild and Jordan, 1903:715.*Hawaiiina wilsoni* (Rothschild) Tutt, 1903:76. Swezey. 1954:37, fig. 10.

Endemic. Hawaii (type locality).

Hostplants: *Acacia koa*, *Bobea*, *Euphorbia*, *Metrosideros*, *Pelea*, *Straussia*.

Perkins (1913:cli) said that it is "known only from Hawaii, where it is generally distributed, the polyphagous caterpillars feeding on many forest trees of different families. In wet districts the moth is freely on the wing at all hours of the day, visiting the flowers of *Metrosideros*, as well as those of cultivated plants, nasturtiums, canna, etc. In drier localities it flies more freely at dusk. We have

seen hundreds together rising straight up from the rough lava flows, that intersect the dense forests of the Hilo district of Hawaii, till they reach the height of the tall tree-tops on either side of the flow."

**Celerio wilsoni perkinsi** (Swezey), **new status** (fig. 375).

*Celerio perkinsi* Swezey, 1920:379.

*Hawaiina perkinsi* (Swezey) Swezey, 1954:37, 112, 207, fig. 10.

Endemic. Oahu (type locality: Mount Tantalus), Molokai.

Hostplants: *Euphorbia*, *Kadua*, *Straussia kaduana*, *Straussia* species.

Parasite: *Trichogramma semifumatum* (Perkins) (22 reared from one moth egg).

Caterpillar green; pupal period, three weeks.

I consider this to be a subspecies of *wilsoni*, instead of a distinct species, in the same way that *hawaiiensis* is considered a subspecies of *calida*.

#### Subfamily SPHINGINAE

*Acherontiinae* (Boisduval) Butler, 1876:517. Rothschild and Jordan, 1903:4.

*Sphinginae* Hampson, 1918:384.

#### Genus **HERSE** Oken, 1815

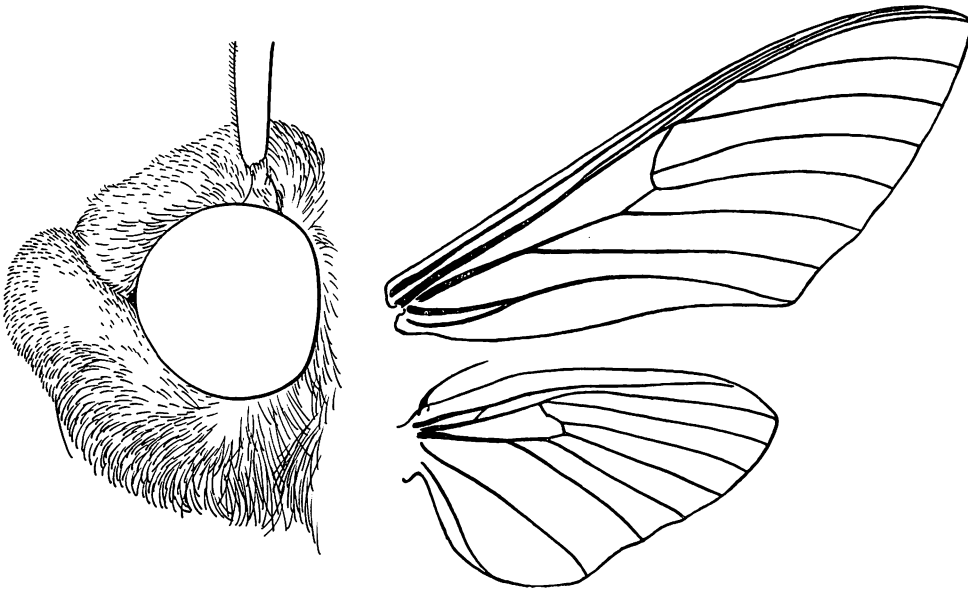


Figure 377—Head (left) and wing venation (right) of *Herse cingulata* (Fabricius).

***Herse cingulata* (Fabricius) (figs. 366, 368, 369, 377, 378).**

*Sphinx cingulata* Fabricius, 1775:545.

*Protoparce cingulata* (Fabricius), Butler, 1877:47.

*Sphinx convolvuli* Linnaeus, Meyrick, 1899:193.

*Protoparce convolvuli* (Linnaeus), Fullaway, 1911:11, fig. 2.

*Phlegethontius cingulata* (Fabricius), Dyar, 1895:95.

*Herse cingulata* (Fabricius) Rothschild and Jordan, 1903:10, pl. LX, fig. 1, pl. xxvi, fig. 17, pl. xxxv, fig. 5.

The sweetpotato hornworm.

Oahu, Molokai, Maui, Hawaii.

Immigrant; described from America; nearly cosmopolitan. First recorded from Hawaii by Butler (1877:47).

Hostplants: *Ipomoea insularis*, *Ipomoea tuberculata*, sunflower (*Helianthus annuus*), sweetpotato, *Xanthium*.

Parasite: *Trichogramma minutum* Riley, *Trichogramma semifumatum* (Perkins), in the eggs.

Predators: *Bufo marinus*, mynah birds.

This species occasionally damages plantings of sweetpotatoes. The caterpillars often become extremely numerous on wild *Ipomoea* (see the notes under *Celerio lineata*).

"In the morning large numbers may sometimes be found attached to the flowers of the wild ginger, which they have visited during the night, and from which they have been unable to withdraw their proboscis. Examples so caught are often devoured by ants during the course of the day." (Perkins, 1913:cliii.)

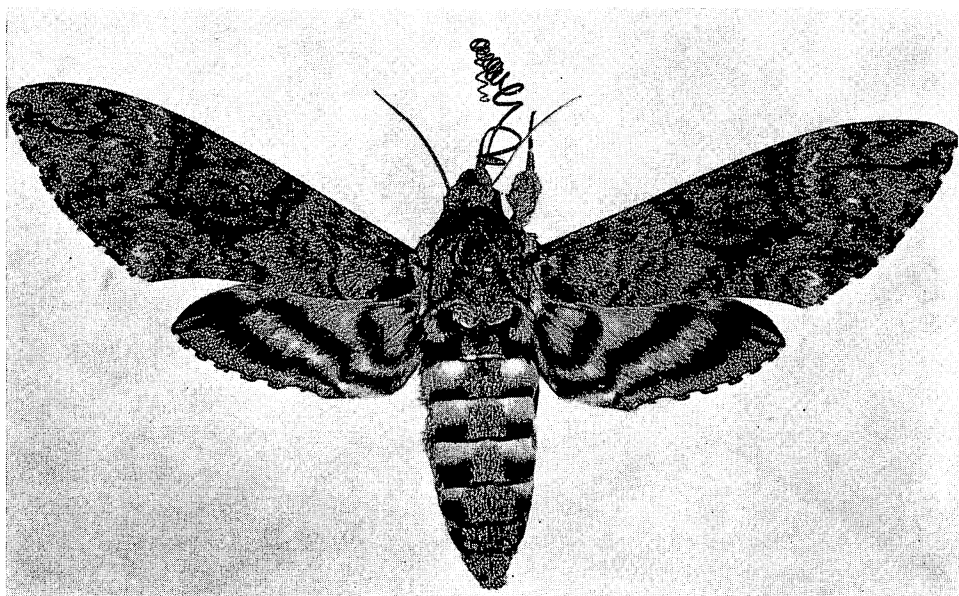


Figure 378—*Herse cingulata* (Fabricius), Kona, Hawaii, 1,500 feet; expanse, 117 mm.



Swezey (1944:141) described the caterpillar as follows: "Body green, which is sometimes obscured by fuscous markings or mottling; spiracles situated in circular dark spots; an oblique dark streak above each spiracle, slanting backward, and sometimes a conspicuous longitudinal dark streak connecting the oblique streaks on dorsum, and mid-dorsal pale streak; prothoracic shield concolorous."

Dyar (1895:95-97) has described the egg, first, second, third, fourth and fifth stage larvae and pupa (from Hawaiian material).

Genus **PHLEGETHONTIUS** Huebner, 1819

*Protoparce* Burmeister, 1855.

It is thought that *blackburni* may represent an earlier natural invasion of Hawaii from America and that it is subspecifically distinct. That may be true, but it appears that a more detailed study of the range of variability under humid tropical conditions and the color phases in other parts of the range of the insect are needed.

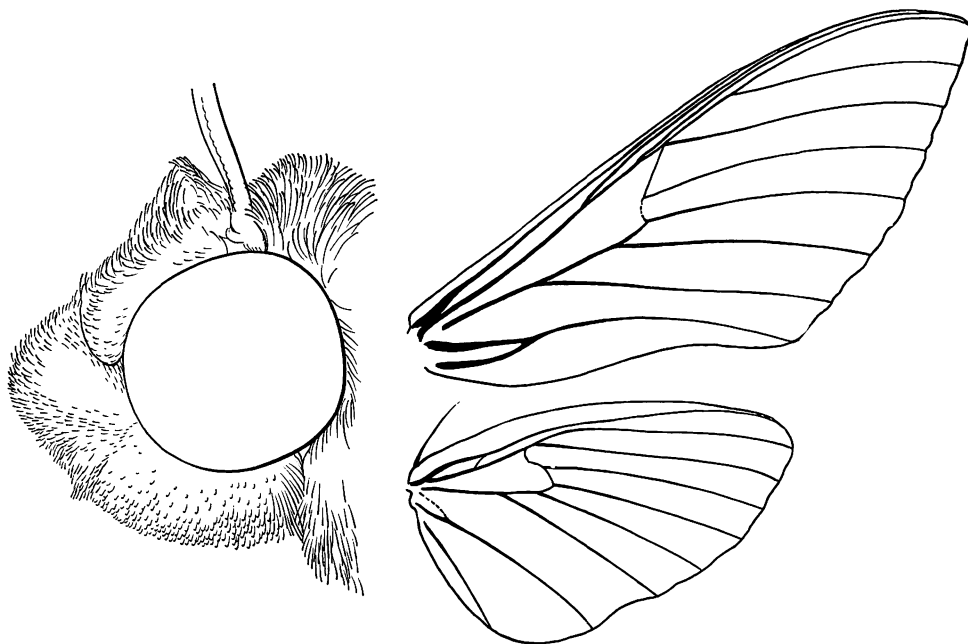


Figure 379—Head (left) and wing venation (right) of *Phlegethontius quinquemaculatus* (Haworth).

## KEY TO THE FORMS OF PHLEGETHONTIUS IN HAWAII

1. The triangular white spots beyond disc on upper side of fore wing comparatively few and not forming a continuous series across the wing; posterior black band on upper surface of hind wing comparatively narrow and farther removed from wing margin than the breadth of the dark band, but variable; as illustrated . . . . . **quinquemaculatus quinquemaculatus** (Haworth).
2. Upper side of fore wing with an almost continuous series of triangular white spots beyond disc from hind margin to costa; hind wing with the black preapical band usually very broad and usually much wider than the distance between the band and wing margin, but variable; as illustrated . . . . . **quinquemaculatus blackburni** (Butler).

**Phlegethontius quinquemaculatus quinquemaculatus** (Haworth) (figs. 368, 369, 379, 380).

*Sphinx 5-maculatus* Haworth, 1803:59.

*Sphinx celeus* Huebner, Meyrick, 1899:193.

*Phlegethontius quinquemaculatus* (Haworth), of authors. Van Dine, 1905:10, fig. 5.

*Protoparce quinquemaculatus quinquemaculatus* (Haworth) Rothschild and Jordan, 1903:72.

The tomato (or tobacco) hornworm.

Oahu, Hawaii (and probably the other islands, but no records available to me at this writing).

Immigrant; widespread in America. First reported from Hawaii by Meyrick (1899:193).

Hostplants: *Solanum*, tobacco.

See Forbes (1948:186) for discussion of the common name and confusion regarding it.

**Phlegethontius quinquemaculatus blackburni** (Butler) (fig. 380).

*Protoparce Blackburni* Butler, 1880:6.

*Phlegethontius blackburnii* (Butler), of authors.

*Protoparce quinquemaculatus blackburni* (Butler) Rothschild and Jordan, 1903:72. Swezey, 1925:49.

The Hawaiian tomato (or tobacco) hornworm.

Endemic. Kauai, Oahu, (type locality: Honolulu), Molokai, Maui.

Hostplants: Eggplant, *Nicotiana glauca* (favored food), cultivated tobacco, *Solanum*, tomato.

This form has been reported, on occasion, to damage severely plantings of eggplant. It may rest in the pupa for about a year.

Butler (1881:319) quoted the following description which Blackburn made of the caterpillar:

Green or ashy grey, more or less sprinkled with white; spiracular line white, emitting upwards and backwards (*i.e.* so that they slant upwards in a backward direction) seven white stripes, the first of which is on the fourth segment (not counting the head as a segment), the last on the tenth; on the eleventh segment is a small white stripe bent backwards over the spiracle, being much

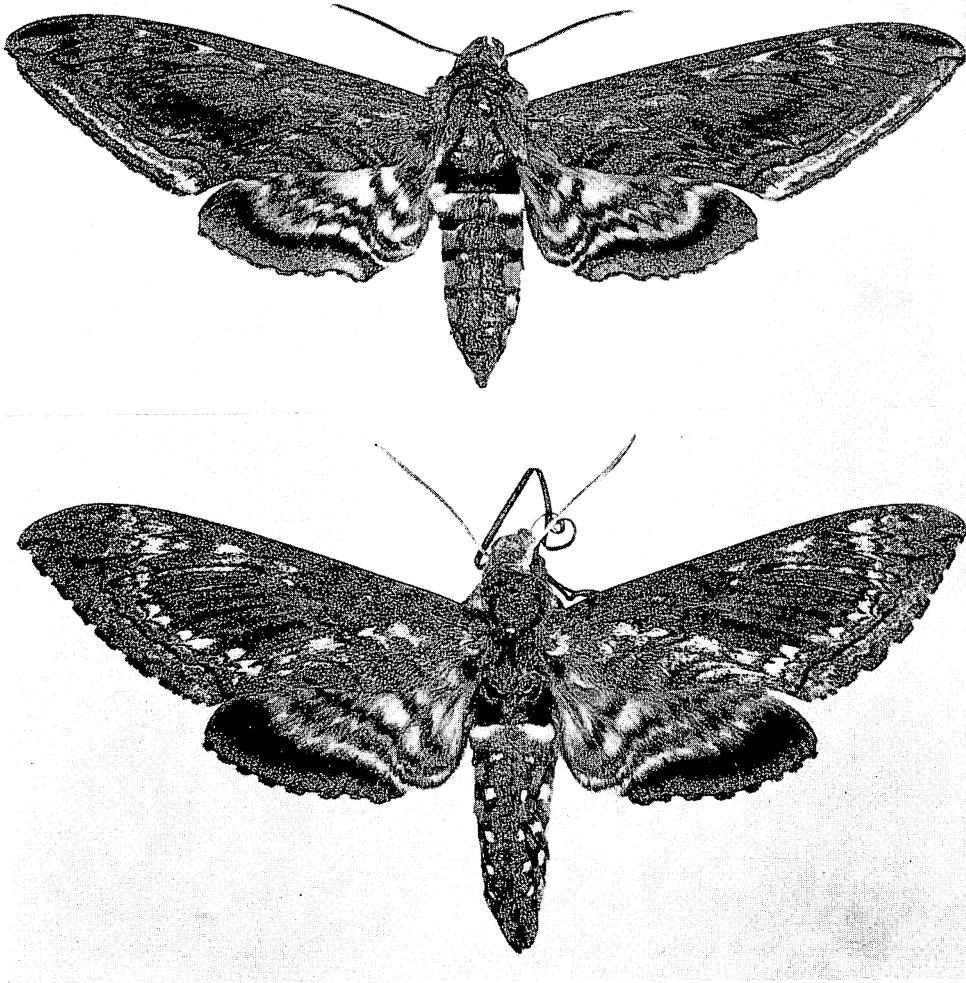


Figure 380—Above: *Phlegelthontius quinquemaculatus quinquemaculatus* (Haworth), Jalapa, Mexico; expanse, 134 mm. Below: *Phlegelthontius quinquemaculatus blackburni* (Butler), type, Honolulu; expanse, 125 mm.

smaller than the white lines on the other segments; head with two well-defined black longitudinal lines, and clouded with black laterally; spiracles black, surrounded with a bright blue ring; horn long, shining black, bent backwards; claspers of the ground-colour. In the ashy grey larvae the whole dorsal surface is sprinkled with white; the segment behind the head is shining black, bordered with white; the last claspers and space round the anus are shining black (at least partially); and the legs are blackish at base, becoming red towards apex. In the green larvae only a few segments near the head are sprinkled with white, and the segment next behind the head, the last claspers and the space round the anus are olivaceous rather than black; the legs, too, are more conspicuously red.

For illustrations of larva, see Peterson (1948:220, figs. L55, D-F).

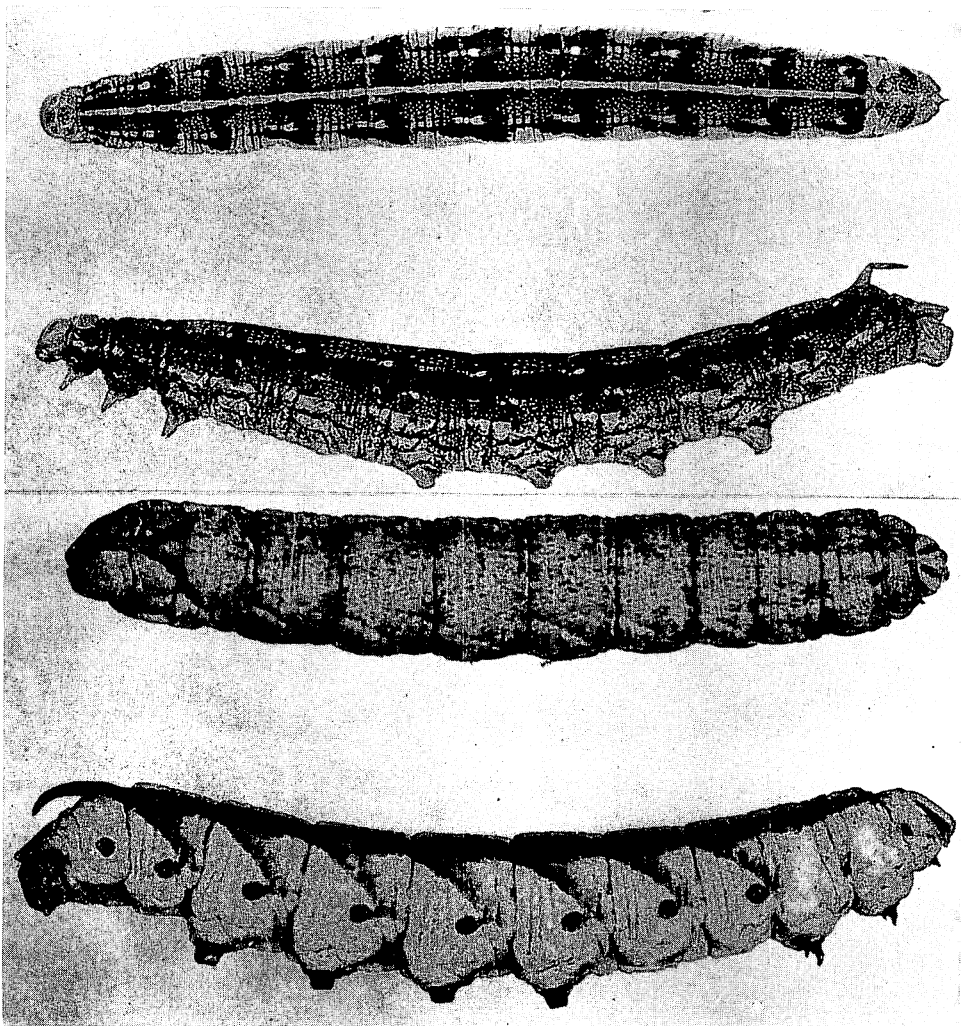


Figure 380-A—Dorsal and lateral views of the caterpillars of two species of Sphingidae. Above: *Celerio lineata* (Fabricius). Below: *Herse cingulata* (Fabricius).

## Series RHOPALOCERA

*Papiliones* Linnaeus, 1758:458.

*Diurni* Latreille, 1802:387.

*Diurnes* Latreille, 1803:319, 320. Duponchel, 1832:377.

*Diurna* Latreille, 1809:186, 193. Leach, 1815:126. Swainson, 1827:187.

*Ropalocerès* Duméril, 1823:139, 222.

*Globulicornes* Duméril, 1823:139, 222.

*Diurni* Boisduval, 1829:7.

*Rhopalocerès* Boisduval, 1833:12.

*Rhopalocera* Boisduval, 1840:1.

## Superfamily PAPILIONOIDEA

*Papiliones* Linnaeus, 1758:458.

*Papilionides* Latreille, 1802:387; 1803:320; 1805:76; 1809:187, 193. Leach, 1815:126. Boisduval, 1840:1.

*Papilionidi* Boisduval, 1829:7.

## The Butterflies

One of the characteristic features of the Hawaiian fauna is that it has only two native butterflies—a red admiral and a blue. In addition to the two endemic species, eight immigrant or introduced species are now established. The skippers (superfamily Hesperioidea) have no members in Hawaii. The only butterfly families represented in our islands are the Pieridae, Nymphalidae, Danaidae and Lycaenidae. It is strange that neither *Hypolimnas* nor *Euploea*, which are so widespread in the Pacific, ever became established in Hawaii.

Butterflies are generally distinguished from moths because they usually fly by day, whereas most moths usually fly at night; they have slender, thread-like antennae which terminate in a club; there is no frenulum; only two anal veins are developed in the fore and hind wings; the maxillary palpi and ocelli are obsolete; the chaetosemata are present. The student is referred to the many standard textbooks on butterflies for detailed information.

Our immigrant or introduced butterflies are all from America, but our two endemic species have come from the western Pacific. It is particularly significant that we can now say that both *Vanessa tameamea* and *Vaga blackburni* have come from islands south of Japan. Each of these butterflies has developed as a distinctive species in Hawaii, but evidently neither has been in Hawaii long enough to have given rise to further species. It may be true that the same fortuitous circumstance was responsible for transporting the ancestral stocks of both of these species from the Bonin Islands, or nearby islands, to Hawaii.

For information on the butterflies of other regions, the reader may refer to the following works listed in the bibliography, plus many other books: J. A. Comstock, 1927; Corbet and Pendlebury, 1956; Distant, 1882; Field, 1938; Ford, 1954;

Frohawke, 1934; Hemming, 1934; Holland, 1905; Hudson, 1928; Kershaw, 1907; Pryer, 1886; Scudder, 1888; Seitz, 1927; Waterhouse and Lyell, 1914; Williams, 1930; Woodhouse and Henry, 1942.

#### SIMPLIFIED KEY TO THE FAMILIES OF BUTTERFLIES FOUND IN HAWAII

It should be noted that this key applies only to the species in Hawaii. Some other Lycaenidae and Nymphalidae, for example, have bare eyes.

1. Eyes bare . . . . . 2  
    Eyes conspicuously hairy . . . . . 3
2. Our species basically white; fore legs normal and fully developed . . . . . **Pieridae.**  
    Our species basically brownish; fore legs greatly reduced and not used for walking . . . . . **Danaiidae.**
3. Our species extensively brown or orange; humeral veinlet (a "spur" arising from near base of subcosta) present in hind wing; fore legs much reduced and useless for walking . . . . . **Nymphalidae.**  
    Our species with some extensive blue scaling; humeral veinlet absent in hind wing; fore tarsi reduced in males or with only one claw or none, but fore legs otherwise developed and used for walking . . . . . **Lycaenidae.**

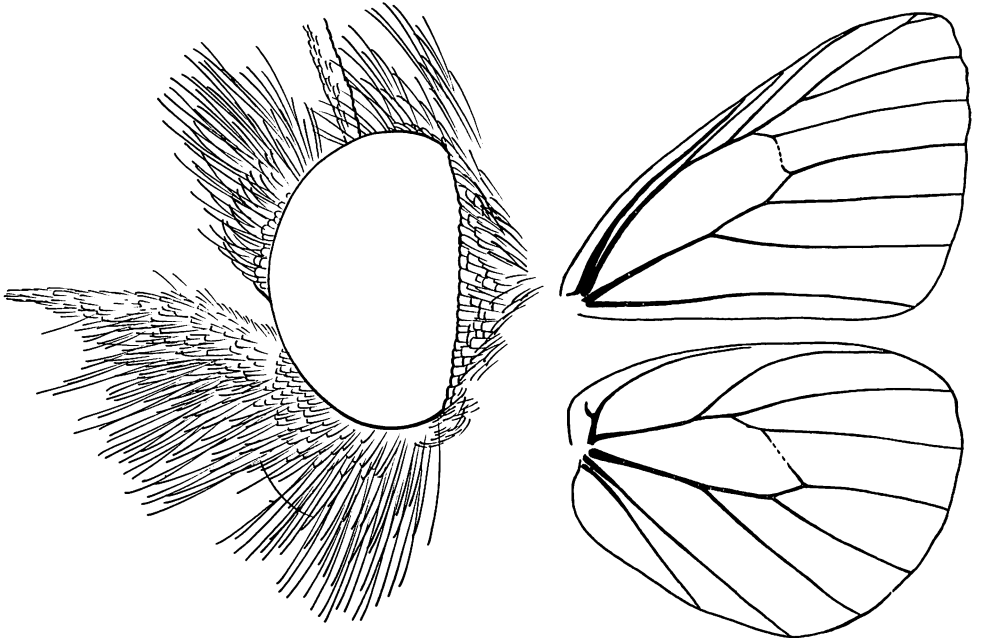


Figure 381—Head (left) and wing venation (right) of *Pieris rapae* (Linnaeus).

KEY TO THE FAMILIES OF BUTTERFLIES IN HAWAII BASED UPON  
THE LARVAE AND PUPAE

A—LARVAE

1. Body with two pairs or many large, conspicuous, simple or spinose dorsal processes. . . . . 2  
Body without such processes, with at most fine hair or minute asperities. . . . . 3
2. Body with a pair of long, soft tentacles on thorax and another pair near end of abdomen; otherwise body nearly naked and conspicuously banded with black, yellow and white rings. . . . . **Danaidae.**  
Body with numerous spinose processes on tergites of most segments; very spiny caterpillars. . . . . **Nymphalidae.**
3. Elongate-cylindrical, not slug-like, covered with fine pile and appearing velvety; exposed green caterpillars on cruciferous plants, *Capparis* and nasturtium. . . . . **Pieridae.**  
Small, slug-like, generally secretive caterpillars; derm covered with minute asperities; never on such hostplants as listed for the Pieridae, often in flowers or seed pods. . . . . **Lycaenidae.**

B—PUPAE

1. Suspended from some object by the tail and hanging free with head downward. . . . . 2  
Attached by the tail but also attached by a silken loop around thorax and not hanging free. . . . . 3
2. Compact, smooth, green or greenish, studded with a row of jewel-like gold dots around base of abdomen. . . . . **Danaidae.**  
With an irregular, in part angulate, surface, brownish or dark. . . . . **Nymphalidae.**
3. Head sharply pointed and with angulate cephalic and thoracic contours. . . . . **Pieridae.**  
Body compact and all contours rounded. . . . . **Lycaenidae.**

See Mosher (1916:78) for details of the pupae of butterflies.

Family PIERIDAE

*Pierides* Duponchel, 1832:381. Westwood, 1840:87. Boisduval, 1840:4.  
*Pieridae* Duponchel, 1844:23.  
*Pierididae* Reuter, 1897:228.  
*Asciadae* Hampson, 1918:385.

The Whites

Some authors treat this group as a subfamily of the Papilionidae.

Genus **PIERIS** Schrank, 1801:152, 161

Hemming, 1934:128, discussion of type.

**Pieris rapae** (Linnaeus) (figs. 381, 382, 383, 384, 385).

*Papilio Danaus Rapae* Linnaeus, 1758:468; 1761:270; 1767:759.



Figure 382—Dorsal and ventral views of a male *Pieris rapae* (Linnaeus) from Honolulu; expanse, 45 mm.



For detailed synonymy and bibliography, see Talbot, 1932:233.  
In some literature, this species has been referred to *Pontia*.

The cabbage butterfly.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

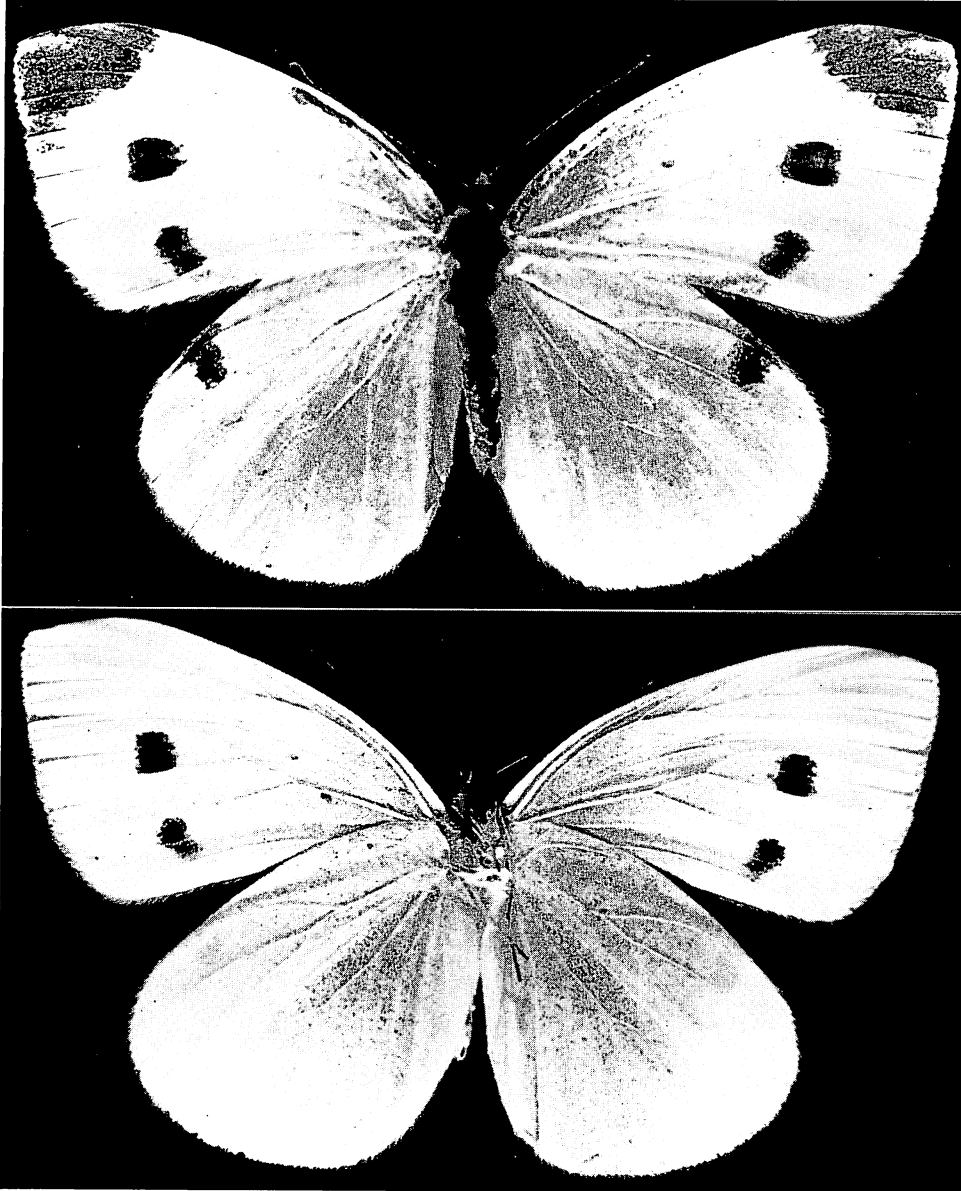


Figure 383—Dorsal and ventral views of a female *Pieris rapae* (Linnaeus) from Honolulu; expanse, 48 mm.

Immigrant; a very widespread species distributed by commerce. First noticed in Hawaii at Honolulu in September, 1898, according to Koebele. Perkins (1913: cliv) says that it was introduced from California in 1897. Meyrick noted its establishment in the Islands in his 1904 report (p. 132).

Hostplants: Broccoli, cabbage (head and Chinese), cauliflower and other crucifers, *Capparis sandwichiana*, nasturtium.

Parasites: *Apanteles glomeratus* (Linnaeus), *Bergoldia virulenta* Tanada (a granulosus virus), *Brachymeria obscurata* (Walker), "flacherie" disease of the caterpillars, *Frontina archippiwora* (Williston), *Pteromalus puparum* (Linnaeus), *Perezia mesnili* Paillot (a microsporidian disease).

Predators: *Pheidole megacephala* (Fabricius) destroys the eggs and *Polistes* wasps feed upon the caterpillars.

This is an economic pest of considerable importance to growers of crucifers, and its attacks also plague the flower gardener. There are several bulletins on the habits and control of this butterfly, and some of these may be obtained from the United States Department of Agriculture. (For example, see Chittenden, 1905).

The caterpillar is pale green with a yellow dorsal stripe, each proleg-bearing segment has a pale, lateral band, and it has a velvety appearance. Lead arsenate or rotenone used to be applied for its control, but there are now various new chemical formulae which may be obtained for use against it.

For a detailed account and illustration of adult and early stages, see Scudder (1889:1205-1218, pls. 7, 65, 72, 84, 88). For illustrations of the larva, see Peterson (1948:192, figs. L41, A-C).

Meyrick (1904:132) quoted the following notes from Perkins: "There is no seasonal dimorphism with it here. It breeds freely on the coast in rocky unin-

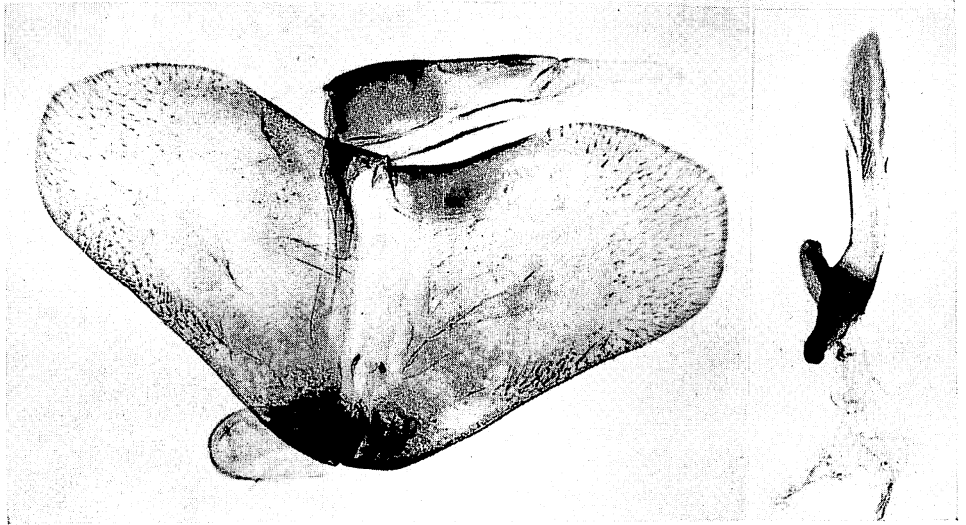


Figure 384—Male genitalia of *Pieris rapae* (Linnaeus), Kawela Bay, Oahu.

habited places on *Capparis sandwichiana*. . . . Though not parasitized, nor attacked much, if at all, in the caterpillar stage by birds, it does not multiply very enormously, since the ants freely devour the eggs, and an introduced wasp skins and carries off the skins of the caterpillar. The butterfly is common in the winter months, but in Oahu becomes very scarce in the summer months. It is already, I believe, on several islands, including Hawaii." Perkins also noted (1913:cliv)



Figure 385—Female genitalia of *Pieris rapae* (Linnaeus), Kawela Bay, Oahu.

that "It would appear that as *Polistes* increases in numbers in the summer after new colonies have been started by the hibernating females, the *Pieris* becomes much less numerous, while as soon as the nests of the wasps are deserted and the state of hibernation begun, the butterflies increase very rapidly and their caterpillars become very troublesome."

For an interesting paper on the relation of the color of background and color of pupae, see Griffiths and White (1888). For a detailed account of the embryology, see Eastham (1927).

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In addition to *Pieris rapae*, one other species of Pieridae has been reported from Hawaii. It is *Colias ponteni* Wallengren, 1860:33; 1861:351. Talbot, 1932:492. Like so many species collected on the expedition of the "Eugenie," the series

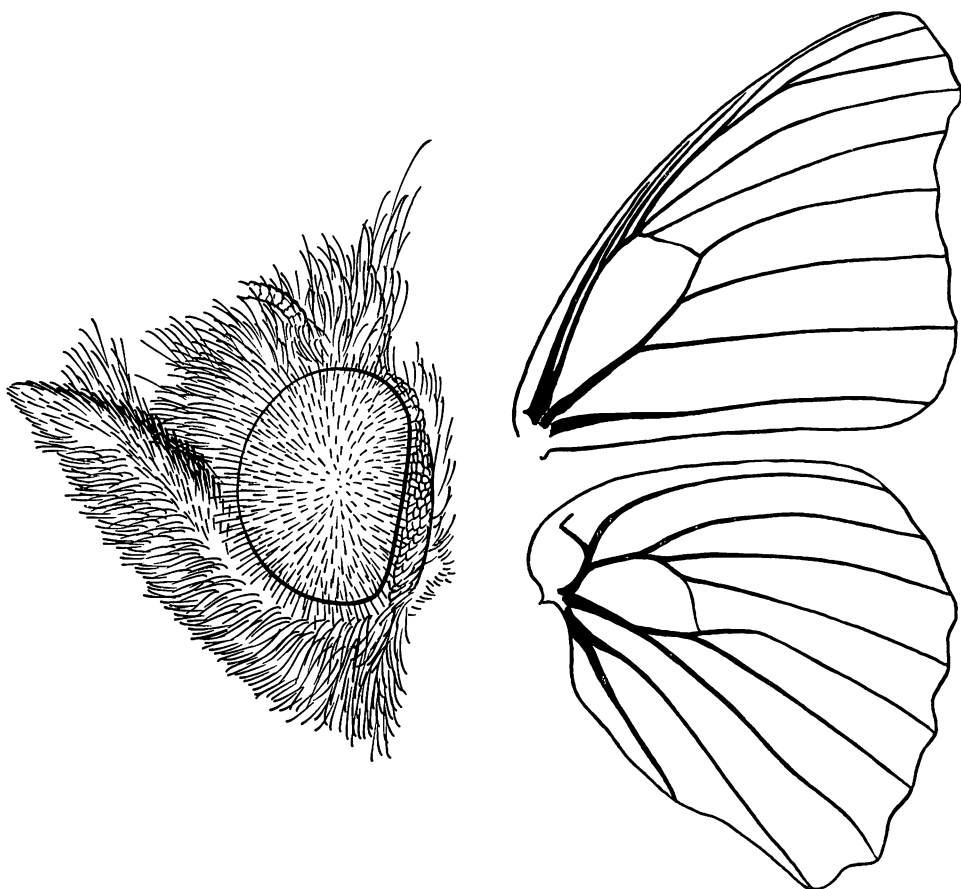


Figure 386—Head (left) and wing venation (right) of *Vanessa tameamea* Eschscholtz.

of this striking and beautiful butterfly has been mislabeled as to locality. The types are in Stockholm; a pair is in the British Museum, and these are labeled "Sandwitsch Inseln" in red ink. Wallengren said that the species was taken at Honolulu in June and July by Kinberg. This species is either the same as *Colias imperialis* Butler, or *imperialis* is a race of it. *Colias imperialis* comes from Port Famine in the Straits of Magellan and it is allied to *Colias minuscula* Butler from Chile. Evidently *Colias ponteni* is one of the World's rarest butterflies in collections.

### Family NYMPHALIDAE

*Nymphales* Linnaeus, 1758:458. Fabricius, 1793: preface.

*Nymphalidae* Swainson, 1827:187.

*Nymphalidi* Boisduval, 1829:14.

*Nymphalides* Boisduval, 1833:39; 1840:16.

*Vanessides* Duponchel, 1832:397.

*Danaidae* Hampson, 1918:385, in part.

*Danainae* Hampson, 1918:385, in part.

### The Brush-footed Butterflies

This is the largest family of butterflies. There are three immigrant and one endemic species in one genus in Hawaii.

### Genus VANESSA Fabricius

*Vanessa* Fabricius, 1807:281.

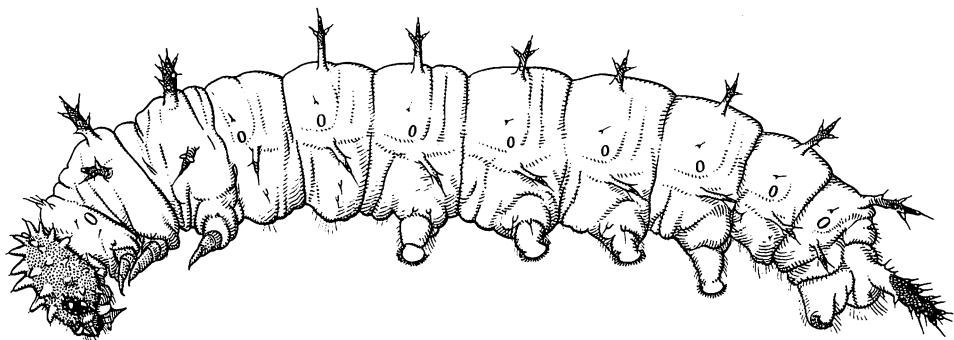
*Pyrameis* Huebner, 1819:33.

### KEY TO THE SPECIES OF VANESSA IN HAWAII

1. Fore wings with a broad red or orange diagonal band from about the basal third of costa toward posterior apical angle, or basal half of wing mostly orange or red . . . . . 2  
Fore wings without such an orange or red diagonal band . . . . . 3
2. Basal half of hind wing orange, apical part with a series of orange spots well separated by black from the wing margin; base of fore wing orange . . . . . **tameamea** Eschscholtz.  
Hind wings black from base to the orange apical band; fore wings black basad of orange diagonal band . . . . . **atalanta** (Linnaeus).
3. Under side of hind wing with two large, well-separated eye-spots . . . . . **virginiensis** (Drury).  
Under side of hind wing with a series of five or six closely placed eye-spots . . . . . **cardui** (Linnaeus).

## KEY TO THE CATERpillars OF VANESSA

1. Proleg-bearing abdominal tergites each with only two large, well-developed spinose processes; with a pair of very large and heavy, unusually developed caudal processes; head with many great tubercles; body with a continuous yellow stripe on each side; folds leaves of Urticaceae: *Boehemeria*, *Neraudia*, *Pipturus*, *Touchardia*, *Urera*.....  
.....**tameamea** Eschscholtz.
- Proleg-bearing abdominal tergites each with four large, well-developed, spinose processes; caudal processes not developed; body with either a continuous yellow lateral stripe, or with dorsal or lateral rows of white or yellow spots.....2
2. Body with a continuous yellow stripe on each side; obscure brown or black, shiny; on thistles, hollyhock, burdock, *Malva*, *Nicotiana glauca*, *Cirsium*, *Xanthium*.....  
.....**cardui** (Linnaeus).
- Body with a dorsal or lateral row of white or yellow spots on each side, but no lateral stripe.....3
3. Purplish brown or black, covered with minute whitish specks; a row of yellow spots on each side; on *Pipturus* and probably other Urticaceae.....**atalanta** (Linnaeus).
- Banded alternately with purplish, yellowish and green; with a row of round, white spots on either side of dorsum from second to eighth abdominal segments; feeds beneath webs on *Gnaphalium*.....**virginiensis** (Drury).

Figure 387—Caterpillar of *Vanessa tameamea* Eschscholtz.

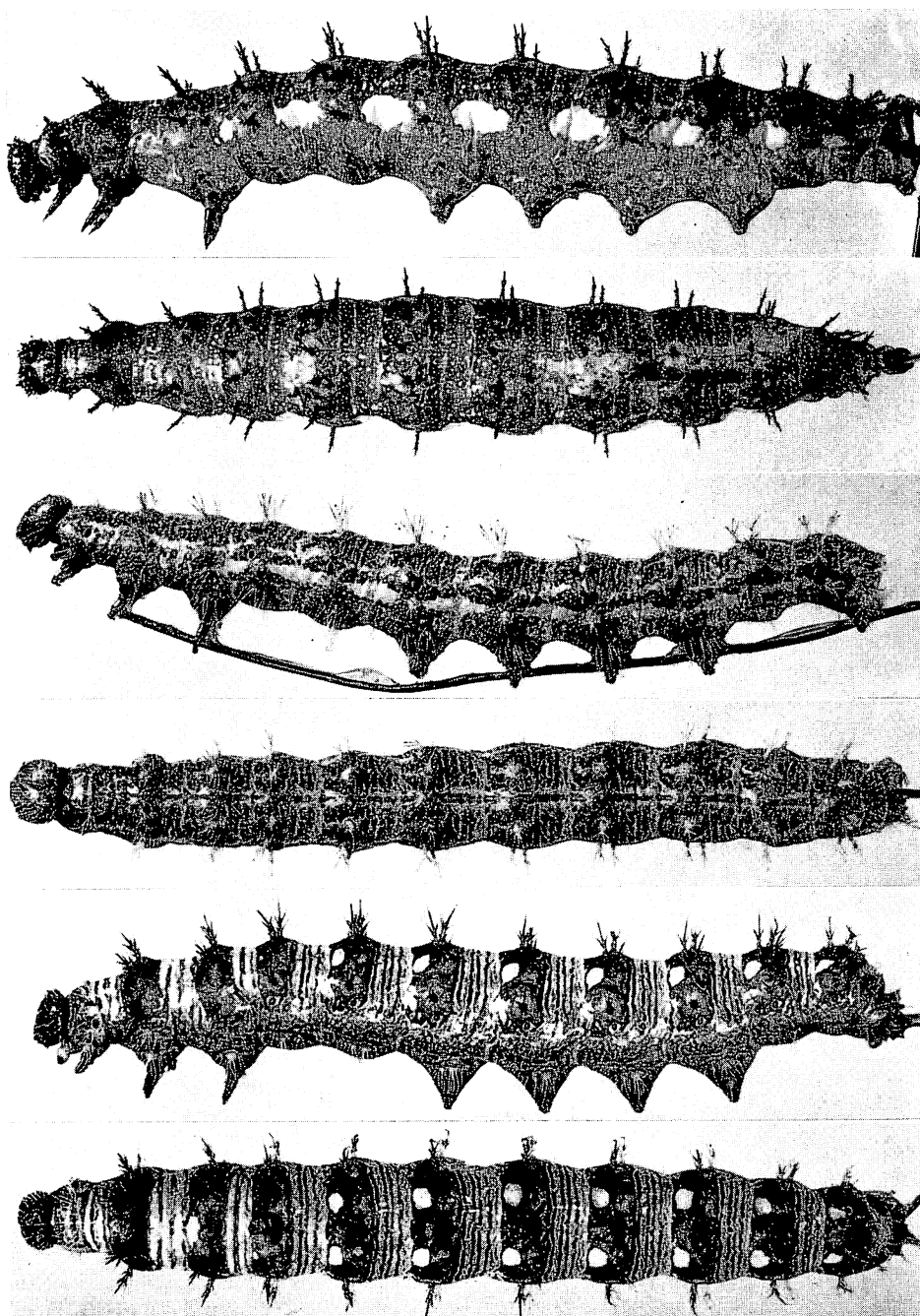


Figure 388—Lateral and dorsal views of the dried, blown, skins of three species of *Vanessa*. Top: *atalanta* (Linnaeus); length, 54 mm. Middle: *cardui* (Linnaeus); length, 47 mm. Bottom: *virginiensis* (Drury); length, 48 mm.

***Vanessa atalanta*** (Linnaeus) (figs. 388, 389, 390, 395, 399).

*Papilio Nymphalis Atalanta* Linnaeus, 1758:478.

*Vanessa atalanta* (Linnaeus), Meyrick, 1899:193. Perkins, 1913:clv. Scudder, 1889:441–456, pls. 2, 20, 64, 70, 81, 83. Field, 1938:81, notes.

The red admiral.

Kauai, Hawaii.

Immigrant. A European species; also widespread in North America. First found in Hawaii by Perkins, who considered it to have been an importation by man after Blackburn's time, because Blackburn did not find it.

Hostplant: *Pipturus albidus*.

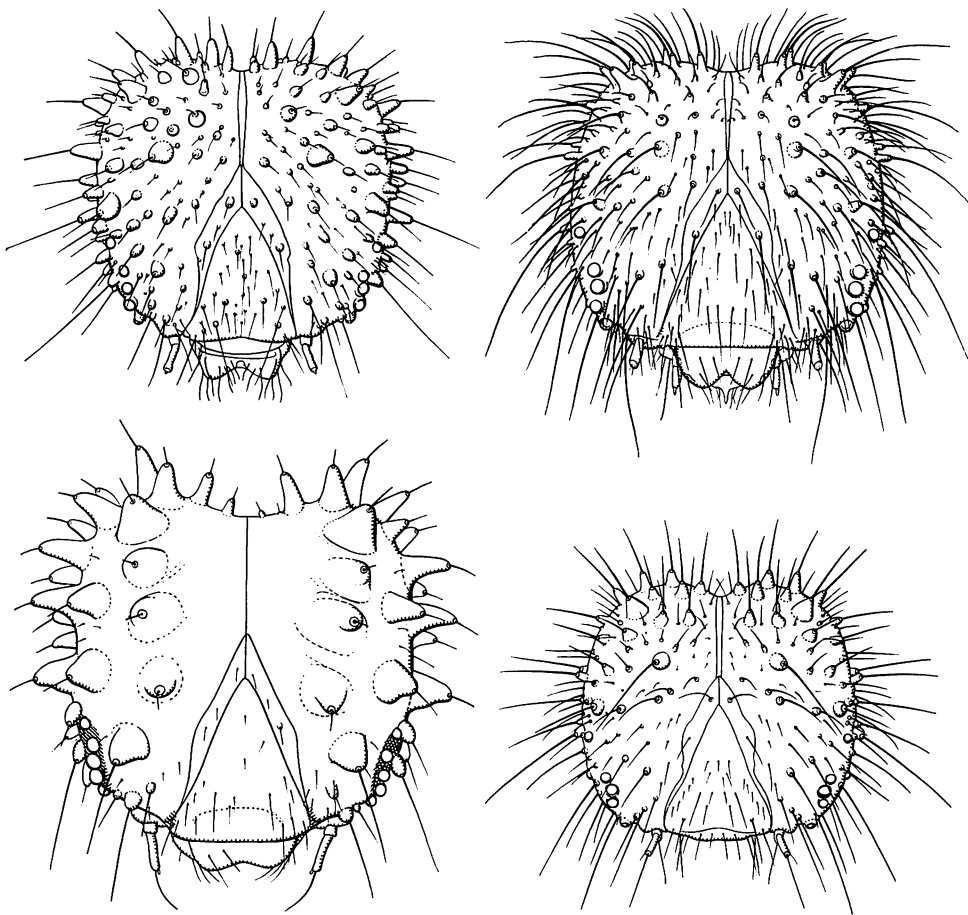


Figure 389—Facial views of the heads of the caterpillars of the four species of *Vanessa* found in Hawaii. Top: left, *atalanta* (Linnaeus); right, *cardui* (Linnaeus). Bottom: left, *tameamea* Eschscholtz; right, *virginiensis* (Drury). The drawing of the specimen of *tameamea* was made from a caterpillar preserved in alcohol; the others were drawn from the dried skins of the examples shown in figure 387.



This species is common in various places on the island of Hawaii. Perkins found it abundant in Kona and at Olaa where he saw the adult feeding at the flowers of *Rubus*. The Kauai record is by Swezey, who collected a single worn example at Kumuwela in 1932. It is not known whether the species is or is not established on the island of Kauai. It is an unusual fact that this strong-flying, widespread butterfly has not become established on all of these islands during the perhaps 70 years since it became established on the island of Hawaii. Its hostplant is one of the commonest and most widespread forest trees of all of the main islands. Other foreign Lepidoptera have become widespread over the islands within a few years of their establishment.

Swezey (1954:157) noted that this species deposits its eggs in clusters on the *Pipturus* leaves, whereas *tameamea*, which also feeds on *Pipturus*, lays its eggs singly.

**Vanessa cardui** (Linnaeus) (figs. 388, 389, 391, 396, 400).

*Papilio Nymphalis Cardui* Linnaeus, 1758:475.

*Vanessa cardui* (Linnaeus), Blackburn, 1879:161. Meyrick, 1899:194. Perkins, 1913:cliv. Field, 1938:85, notes.

The painted lady.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. A European species which has become very widespread about the world and is now considered to be the most widespread of all butterflies.

Hostplants: *Arctium lappa* (burdock), *Artemisia vulgaris*, *Cirsium lanceolatum* ("Scotch thistle"), hollyhock, *Malva rotundifolia*, *Nicotiana glauca*, thistle, *Xanthium*.

Parasites: *Chaetogaedia monticola* (Bigot), *Echthromorpha fuscator* (Fabricius), *Frontina archippivora* (Williston), *Pteromalus puparum* (Linnaeus), *Pterocormus rufiventris* (Brulle), *Trichogramma minutum* Riley.

Perkins (1913:cliv) reported that the caterpillars sometimes entirely strip their hostplants and that he had "even seen the caterpillars perishing of starvation" as a result. He also noted that "A considerable percentage of the Hawaiian *cardui* are intermediate between the var. *kershawii*, which has been considered by some a distinct species, and typical *cardui*, while some are typical *kershawii*. Eggs laid by the same female may produce both forms and intermediates."

Blackburn (1879:161) said,

I have observed the species in considerable abundance (but not in compact swarms) at various points on the Hawaiian Archipelago, between February and July this year (1879),—though I have not previously noticed it during the three years I have been living in the islands. Its near ally, *V. Huntera*, has occurred in about the usual numbers. The season has been here, probably, as much cloudier and more showery than usual as in Great Britain. *V. cardui* has been previously recorded, I believe, as occurring on the Hawaiian Islands, but I cannot at this moment lay my hands on the authority.

The record referred to is probably that of Edward Doubleday (1844:79), also referred to by Scudder in the following quotation.

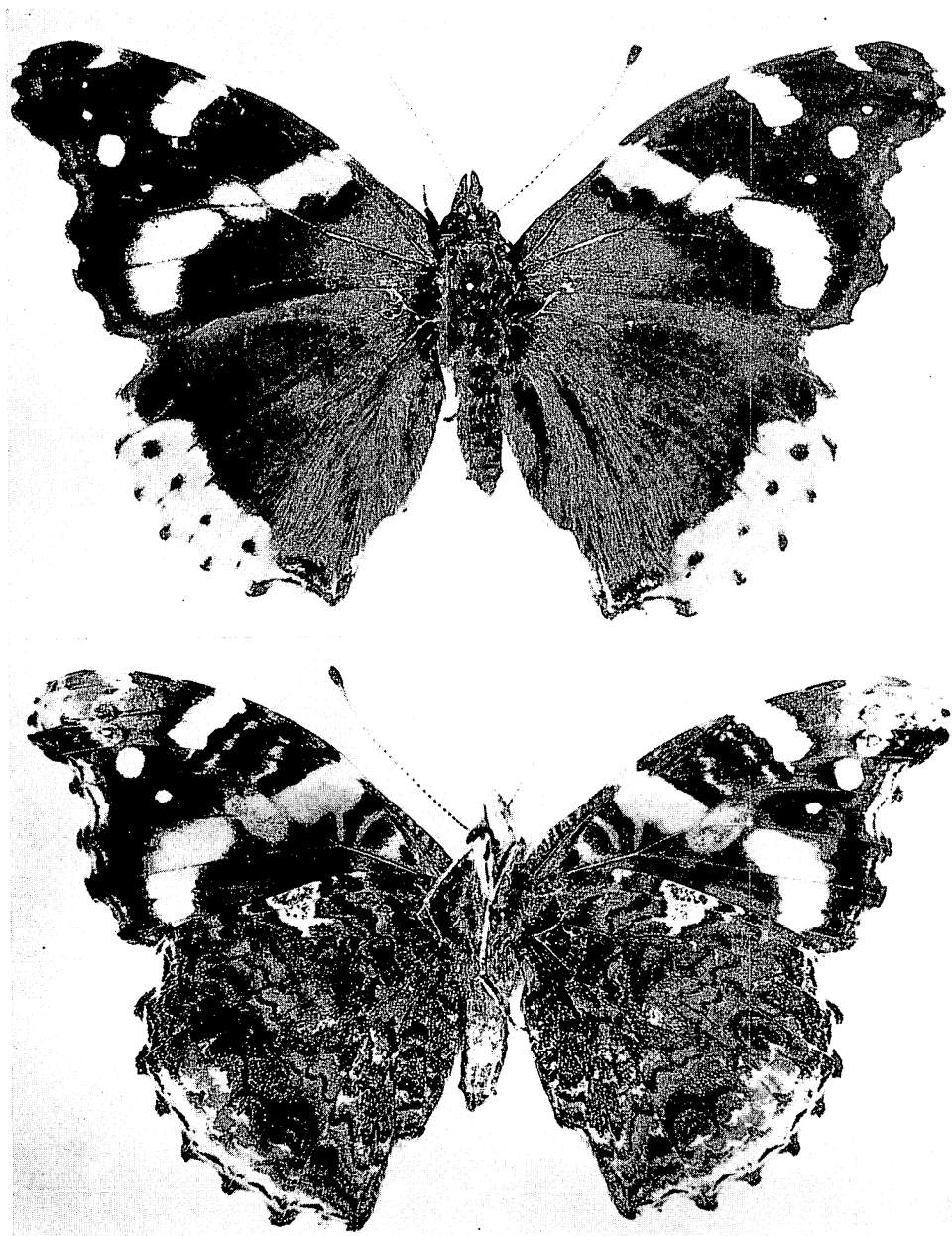


Figure 390—Dorsal and ventral views of *Vanessa atalanta* (Linnaeus); expanse, 60 mm. Hawaiian example.

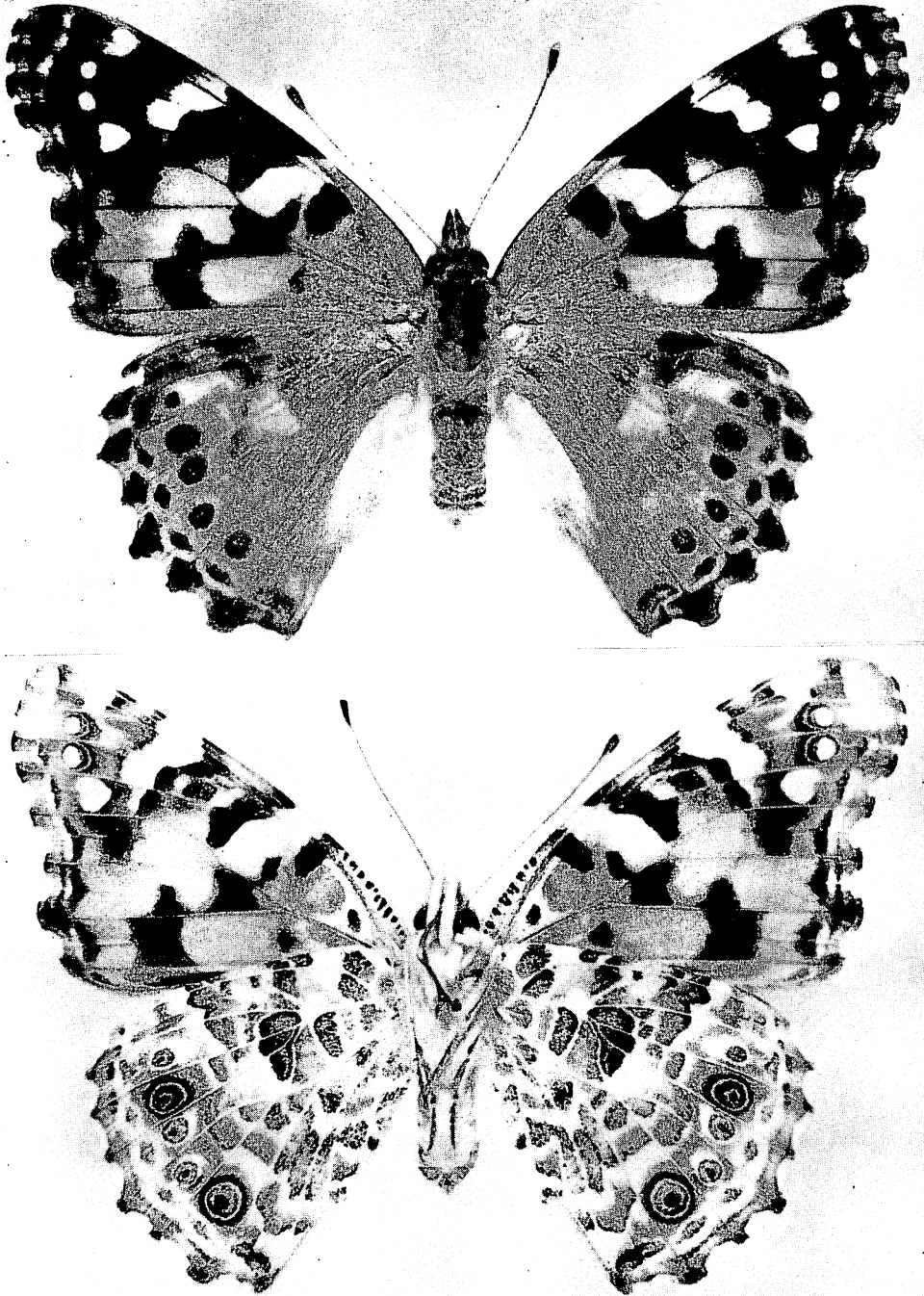


Figure 391—Dorsal and ventral views of *Vanessa cardui* (Linnaeus); expanse, 58 mm.; Mt. Tantalus, Oahu.

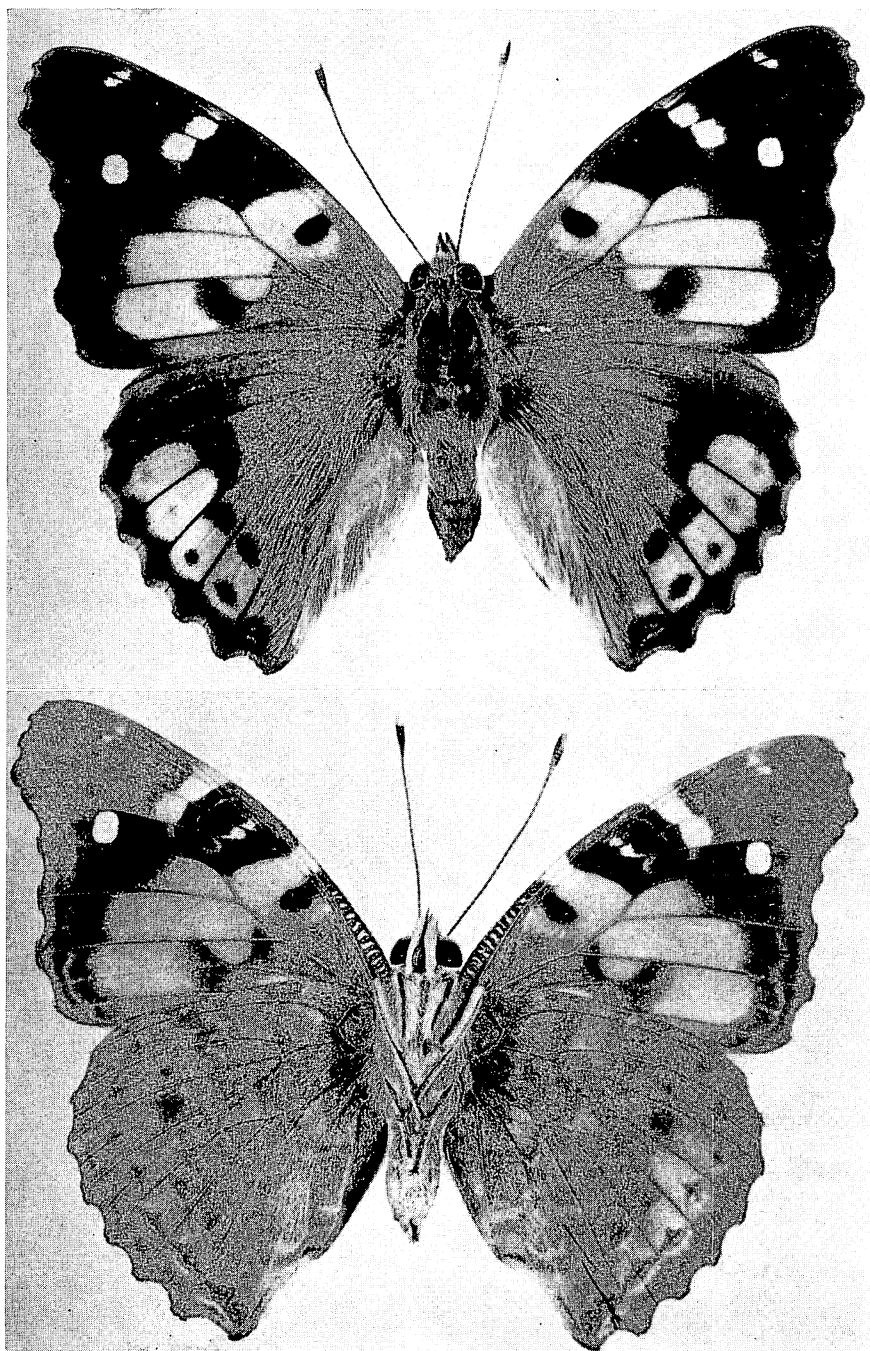


Figure 392—Dorsal and ventral views of a male *Vanessa tameamea* Eschscholtz; expanse, 60 mm.; Oahu.



Figure 393—Dorsal and ventral views of a female *Vanessa tameamea* Eschscholtz; expanse, 67 mm.; Oahu.

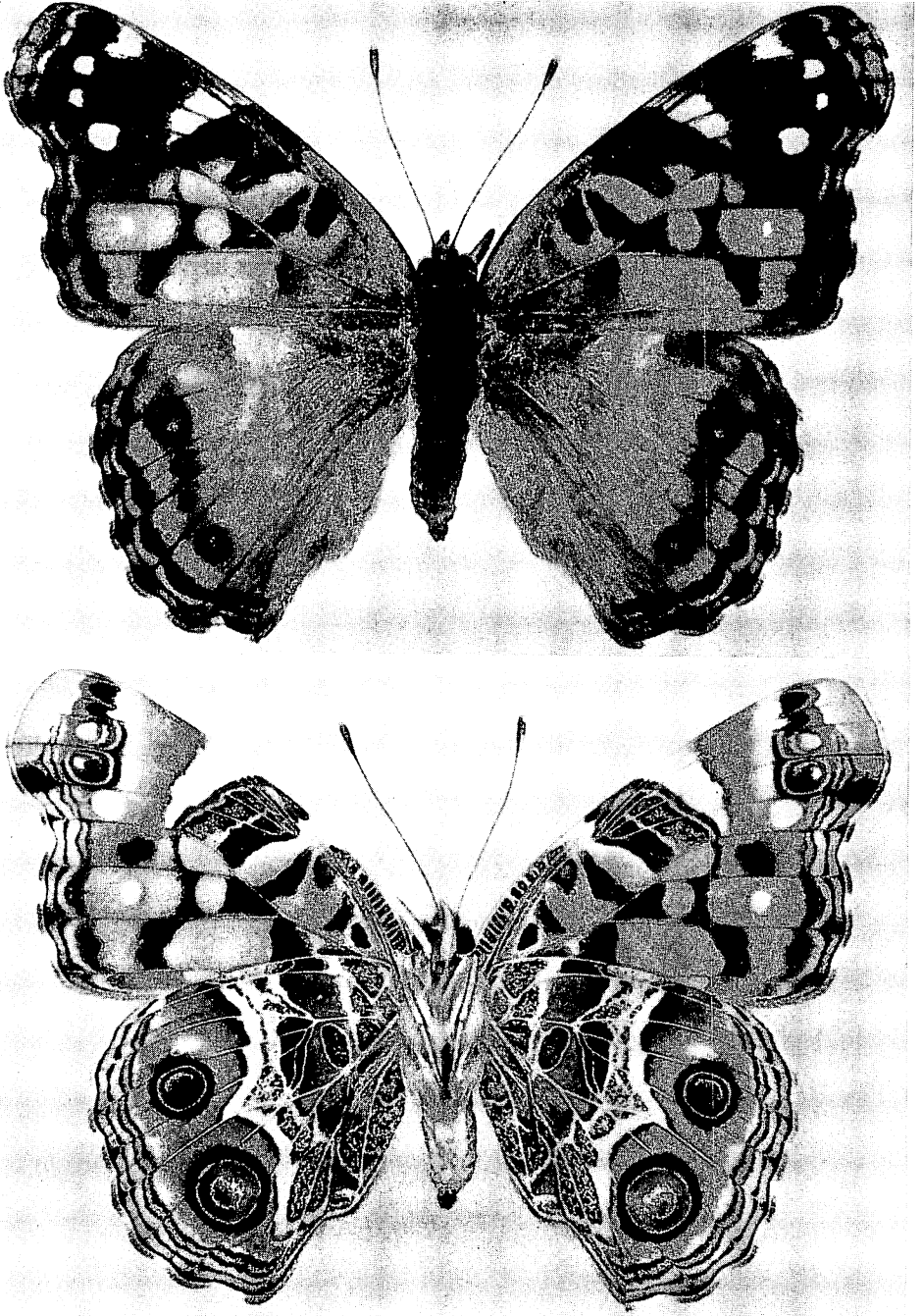


Figure 394—Dorsal and ventral views of *Vanessa virginiensis* (Drury); expanse, 53 mm.; Mt. Tantalus, Oahu.

Scudder (1889:469–487, pls. 2, 21, 64, 74, 81, 83) had the following to say (p. 478–479):

A citation of the Hawaiian Islands will be found in the first List of the British Museum butterflies, where (p. 79) Mr. Doubleday credits four specimens to those islands, two brought by Captain Byron and two by Captain Beechey. I was informed by Mr. Butler some years ago that there was then only one specimen in the museum from the "Sandwich Islands," and the reference upon the ticket is to the oldest manuscript register, not now to be found. Byron and Beechey were at the islands in 1825–27. Mr. W. T. Brigham informs me that *V. cardui* was not found by Mr. Mann and himself during a twelvemonth's residence at the islands twenty or more years ago. Dr. Pickering writes that it was unknown when Wilkes' expedition visited the islands in 1840–41. The Vincennes, to which Dr. Pickering was attached, was at the islands from the end of September to the beginning of April. Byron and Beechey's visits were between the latter part of January and the middle of July. Mr. Butler does not consider the specimen in the British Museum, nor the record of Doubleday, sufficient authority to include this insect in his list of South Sea butterflies. Upon the whole, we cannot fairly accept the present authority for the presence of this insect in the Pacific Islands, unless, as said above, it has been recently introduced. Mr. Blackburn writing to the Entomologist's monthly magazine, says it appeared in considerable abundance in 1879 at various points in the Hawaiian archipelago, though not previously noted in two years' residence there. Dr. H. Behr of California wrote me in 1877 that he had received it from Honolulu where it was collected by Mr. Leykauff about the year 1859.

I have little doubt that the records attributed to Byron and Beechey were correct; it is noted elsewhere in this text that other specimens of Lepidoptera were obtained by Beechey in Hawaii.

**Vanessa tameamea** Eschscholtz (figs. 386, 387, 389, 392, 393, 397, 401).

*Vanessa Tameamea* Eschscholtz, 1821:207, pl. 5, figs. 8a, 8b.

*Pyrameis cordelia* Doubleday and Hewitson, 1847, pl. 25, fig. 3.

*Pyrameis Tammeamea* (Eschscholtz) Doubleday and Westwood, 1849:204 (misspelling). Tuel, 1878:234.

*Vanessa tammeamea* Eschscholtz, Meyrick, 1899:193, pl. 5, fig. 9. Perkins, 1913:clv. Williams, 1928:164. Swezey, 1954:157, figs. 26, 27, 28.

The Kamehameha butterfly.

Endemic. Kauai, Oahu (type locality), Molokai, Maui, Lanai, Hawaii.

Hostplants: *Boehmeria*, *Neraudia*, *Pipturus albidus* (principal host), *Touchardia* ("olana"), *Urera*—all members of the Urticaceae, or nettle family.

Parasites: *Brachymeria obscurata* (Walker), *Echthromorpha fuscator* (Fabricius), *Pentarthron flavum* Perkins, *Trichogramma minutum* Riley, a "wilt" disease.

This was the first species of Lepidoptera to have been described from the Hawaiian Islands. Some authors have allied it to the New Zealand *Vanessa gonerilla* (Fabricius), but I do not share that opinion. I consider it to be a derivative of *Vanessa indica* (Herbst), a great wanderer, which is known from Madeira, the Canary and Balearic Islands, Portugal and southern Spain and is widespread from India, Ceylon, Burma, China, Korea, the Philippines, Celebes and other islands and extends its range into the Marianas and vicinity. It is probable that the Hawaiian form became established from an original immigrant stock from the Mariana or Bonin Islands or vicinity.

This fine butterfly is generally distributed throughout the forests of the Hawaiian Islands, and it is often seen high on mountaintops and occasionally near the seashore. It is frequently seen in the lowlands following periods of strong winds, and, in the absence of suitable hostplants, the females may lay their eggs (singly) on various plants which will not sustain the larvae. Perkins (1913:clv) reported seeing a female laying eggs on a malvaceous plant in Honolulu, but the young caterpillars refused to feed on the plant and died of hunger. Perkins fed

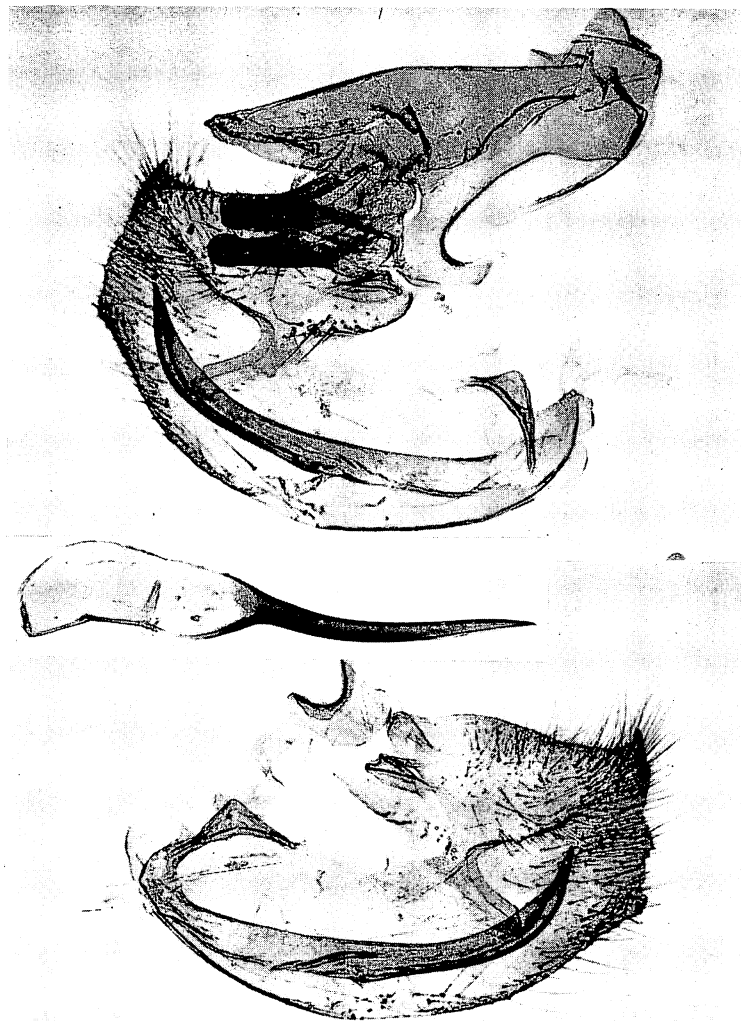


Figure 395—Male genitalia of *Vanessa atalanta* (Linnaeus); Olaa, Hawaii. Above: Lateral view with right valve removed. Center: Aedeagus. Below: Right valve, inner side.



some of the caterpillars *Pipturus* leaves, and they developed normally on them. I had a similar experience in 1946 when I observed a female ovipositing on sunflower plants in my garden in Honolulu after she had been driven out of the mountain forest by a strong wind.

The butterfly itself is remarkable for the great variation of the under side of the wings, whereas the coloration of the upper side varies but little. . . . The flowers of *Broussaisia* are often very attractive to this butterfly, as are those of an introduced *Rubus*, but more often it is found feeding on the exuding sap of *Acacia koa*, *Myoporum*, and other common forest trees. . . . The caterpillars are very variable, being sometimes green or purplish or particoloured. . . . Although the butterfly bears a general resemblance to other species of *Pyrameis*, the caterpillar is so very distinct, that it would be taken to belong to some other genus. The very numerous stout spines with which the head is set, the absence of any mediodorsal line of spines, and the enormous development of two apical abdominal ones, give it an extraordinary appearance. (Perkins, 1913:clvi.) [I can fully support Perkins' observations on the unusually distinct larva.—E. C. Z.]

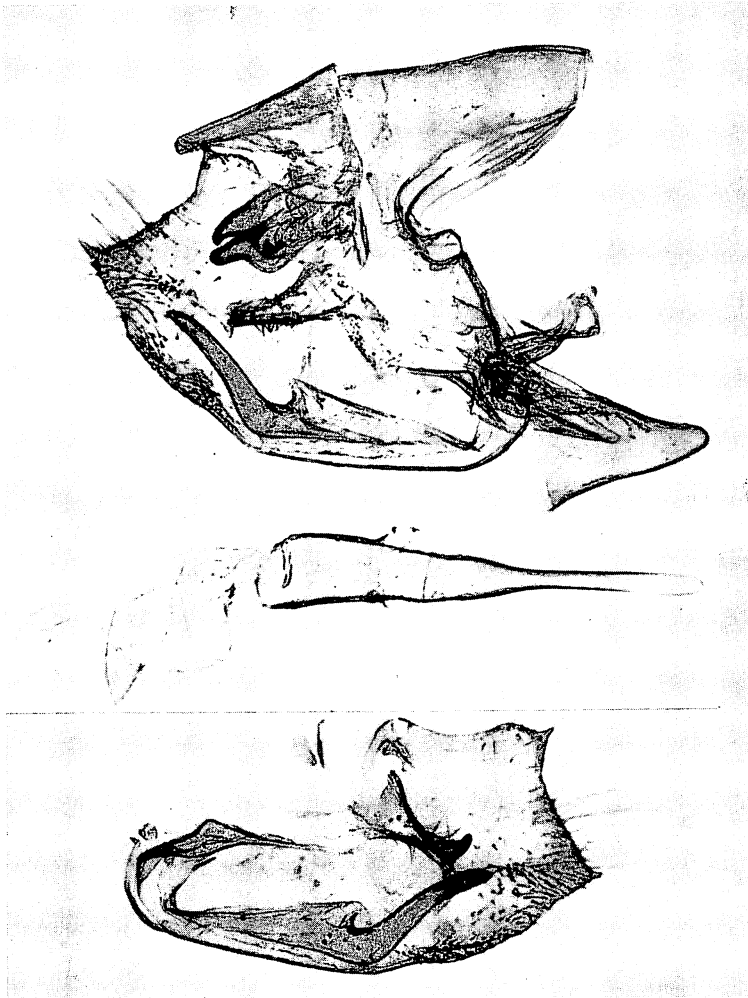


Figure 396—Male genitalia of *Vanessa cardui* (Linnaeus); Kaholuamano, Kauai. Above: Lateral view with right valve removed. Center: Aedeagus. Below: Inner view of right valve.

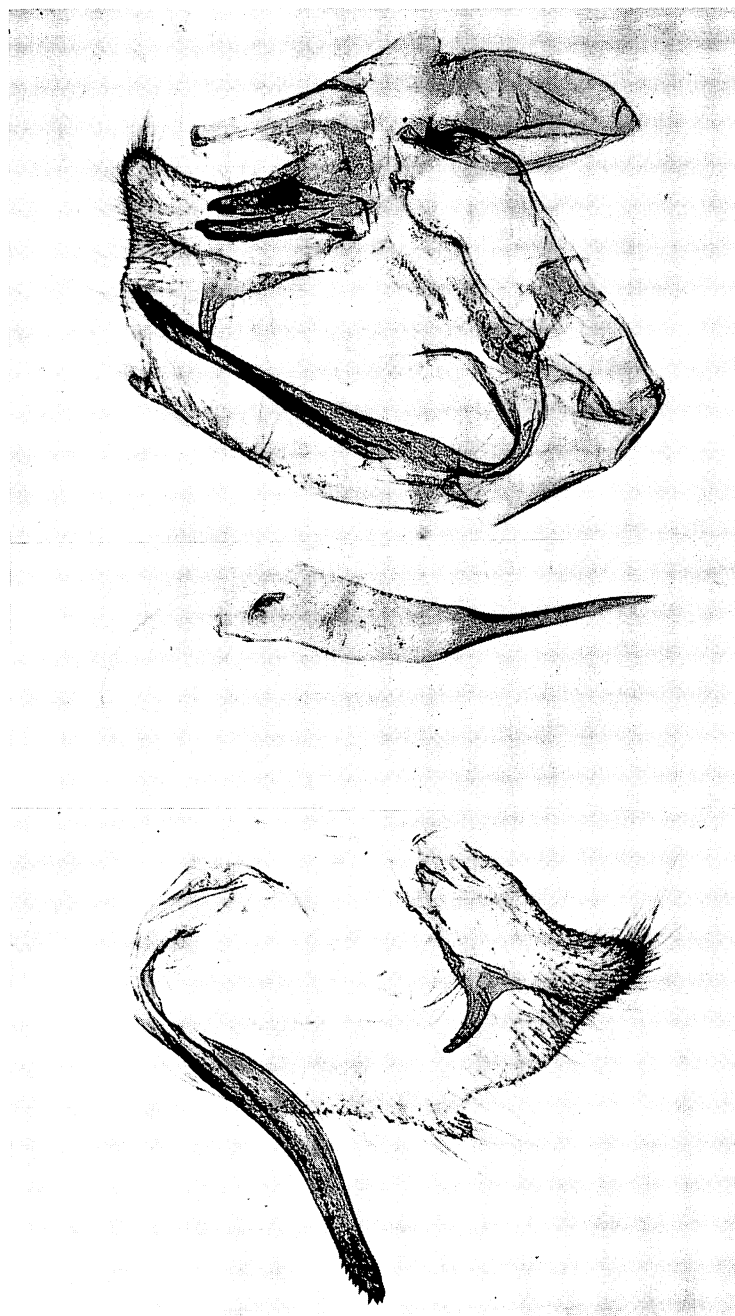


Figure 397—Male genitalia of *Vanessa lameamea* Eschscholtz; Kilauea, Hawaii. Above: Lateral view with right valve removed. Center: Aedeagus. Below: Inner view of right valve.

... in the mountains it is often semi-gregarious on the edge of a wood or in a small clearing, having a particular fondness for resting on the trunk and limbs of rugged old Koa trees. Very often it is the moisture or sap that attracts them there; at any rate it is no easy matter to discern one of these insects as it rests with the dull colored underside of its closed wings resembling somewhat the bark of the tree. When conscious of danger the butterfly partly opens its wings, thus displaying its truly gorgeous livery and shuts them again, often in a trembling manner; it is a rather difficult insect to net and when captured its vigorous struggles often render it quite unfit for a cabinet specimen. The females may be distinguished from the male by the presence towards the apex of the forewings of several white spots [orange in the male]; in addition she is a generally larger insect with the forewings somewhat wider towards their tips. ... The young larva makes a shelter for itself by cutting in from the margin of a leaf and turning the resulting flap and fastening it down upon the leaf by means of silk; as it moults and increases in size the old retreats are abandoned for one of greater size, although in the last instar when the caterpillar has nearly attained its full growth no true shelter is formed, and it is then to be found freely upon the shoots and leaves. By far the larger number of these caterpillars are now mainly a bright green, and provided with inoffensive spines, a very few, however, may be a deep wine brown or sort of purplish with a contrasting line on the side of yellowish. What few chrysalids were seen in the field were suspended by the tail from the twigs of *Pipturus*. [Not infrequently the chrysalids are found on plants

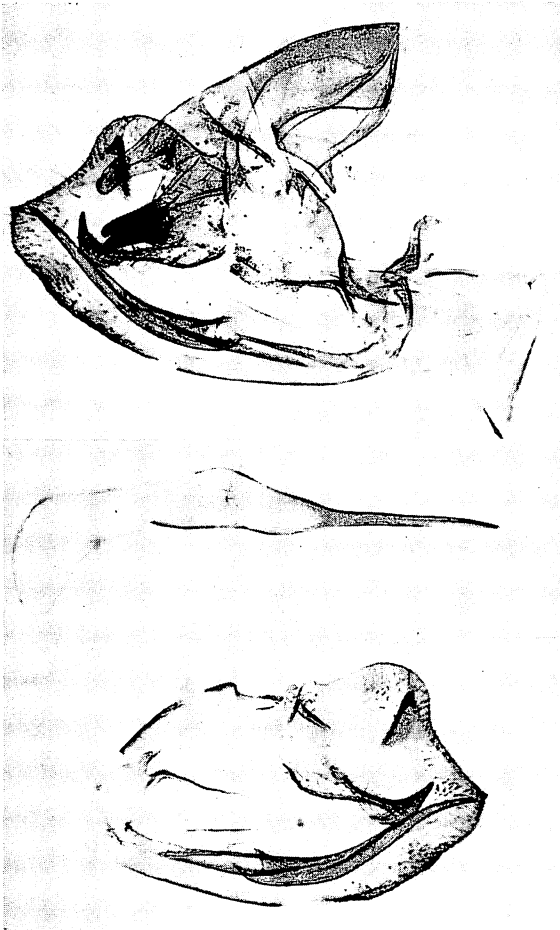


Figure 398—Male genitalia of *Vanessa virginiensis* (Drury); Kona, Hawaii. Above: Lateral view with right valve removed. Center: Aedeagus. Below: Inner view of right valve.

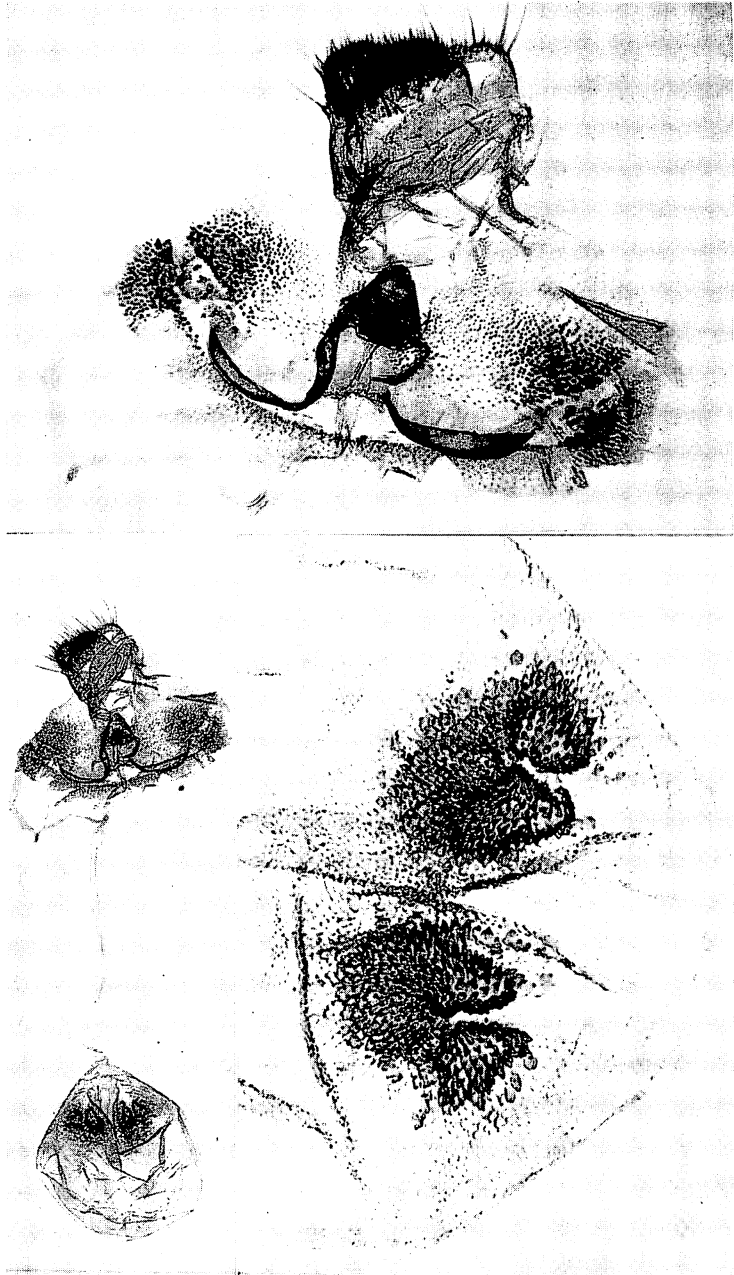


Figure 399—Female genitalia of *Vanessa atalanta* (Linnaeus); Olaa, Hawaii.

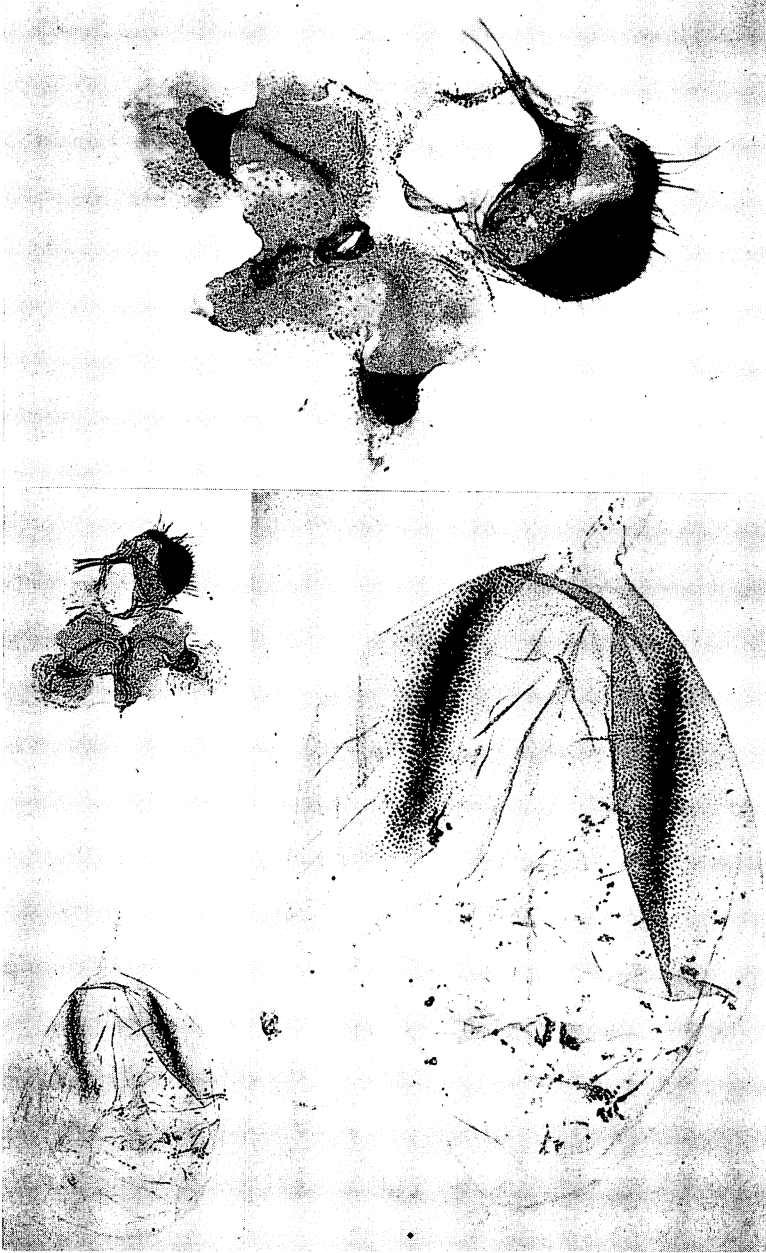


Figure 400—Female genitalia of *Vanessa cardui* (Linnaeus); Lanai.

other than the hostplants, and this may lead to erroneous hostplant records if the observer is not careful.—E. C. Z.] In order to pupate, the caterpillar becomes shorter and stouter, spins a mat of silk, which it soon grasps firmly in its anal prolegs, letting go its hold elsewhere swings down suspended tail first; this procedure, of course, is a matter of some hours, many more of which are necessary before it sheds its skin to turn into a pupa; it will be seen that the skin wrinkles somewhat as if becoming freed of the body of the caterpillar which straightens out as the next stage approaches, finally undulating movements—from head to tail—become apparent, a rent behind the back of the head appears in the caterpillar's skin and the pupa can almost be said to crawl out of it, the skin drawing farther and farther tailwards, though still firmly clinging to the silken sheet; at the last the skin is shriveled and free of the newly formed, high shouldered pupa, except towards the tail end of the venter, where it is firmly gripped, seemingly between two segments; the pupal tail armed with the cremaster, a stout peg-like process bearing fine hooks pulls out of the skin and during the vigorous turnings that now take place, hooks itself firmly into the mat of silk; the shrunken and inconspicuous skin usually dropping off in the scuffle. The soft pupa hardens and assumes a better proportioned form; it is not a conspicuous object and if suspended near or among dry *Pipturus* leaves of pale grey and black shades, may indeed be difficult to locate. In perhaps ten days or so, the color and pattern of the butterfly's wings are visible through the wing cases, the abdomen telescopes out a little, and eventually the seams behind the head, at middle of the back of the thorax and before the wings give way before the struggles of the butterfly which pulls itself out, turns about and grasping the now empty shell suspends itself from it so that its stubby little wings may expand and stiffen. It is a matter of several hours before the butterfly is strong enough to take wing and be off.

Not very much success, however, attended my efforts to rear these butterflies. Hundreds of caterpillars were secured in about a half a year's time and given plenty of fresh leaves and space; but they proved delicate and temperamental and if they did undergo their metamorphosis successfully, more often than not undersized adults were the result. Sensitive and irascible too, it would appear, directly that the twig upon which such a caterpillar rests is disturbed it rears the fore part of the body to attention, and upon further molestation swings it vigorously from side to side,

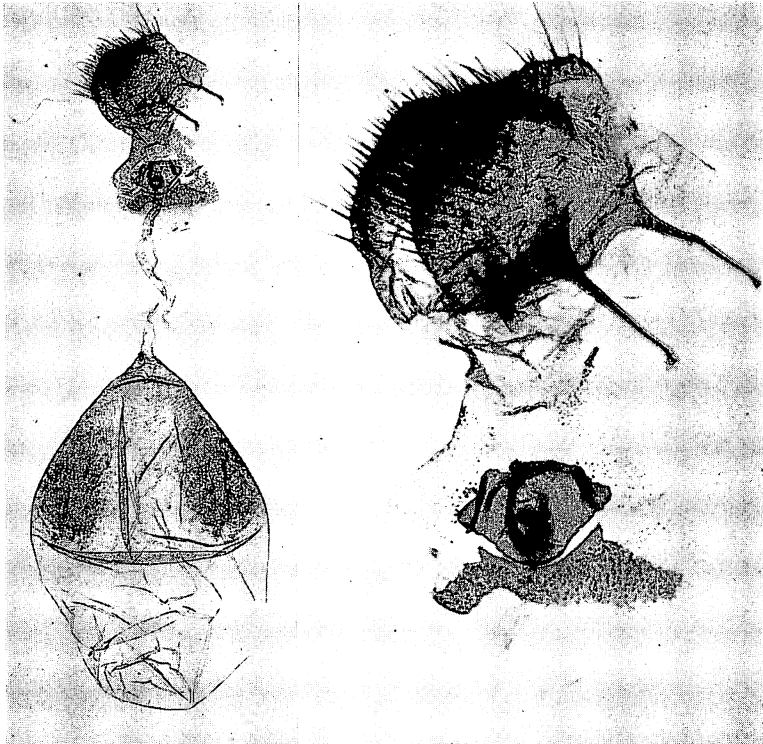


Figure 401—Female genitalia of *Vanessa tameamea* Eschscholtz; Kauai.

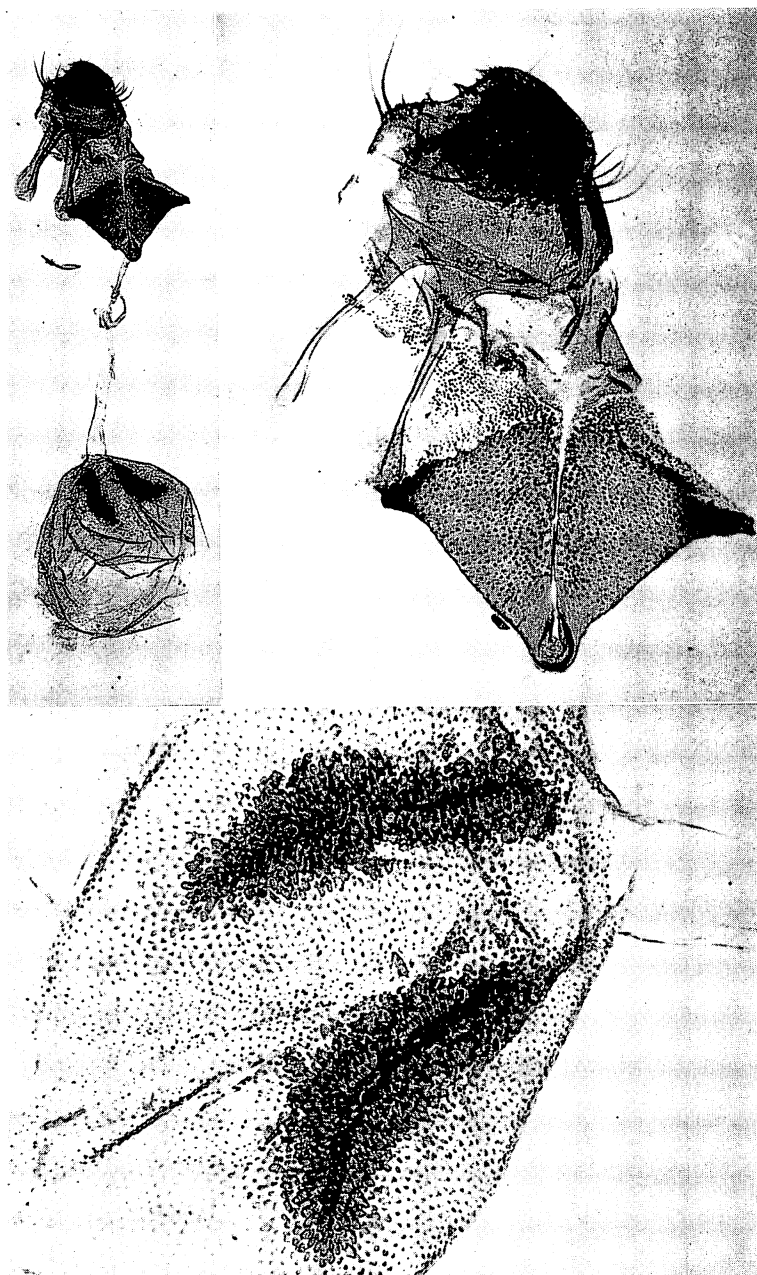


Figure 402—Female genitalia of *Vanessa virginiensis* (Drury); Kona, Hawaii.

emitting at the same time a dark fluid at the mouth, thereby smearing considerably itself or any offending object; this effusion I am sure is detrimental to the larva as it thus loses considerable alimentary fluid in its exertions. This aggressive defence or most of it is soon lost in captivity . . . Only when the caterpillar is making ready to pupate may it again become very agitated though now ejecting no more fluid.

A great number of last stage larvae contracted a disease quite comparable to the wilt of the Gypsy moth caterpillar in the eastern United States; from a healthy green they would turn to a pale sickly yellowish green, lose their vitality, their appetite and regular intestinal functions and finally turning almost suddenly to blackish, at the same time the tissues breaking down, would practically deliquesce so that the greater part of the unfortunate insect spattered upon the leaf below. This was by no means just a laboratory condition—but many similarly diseased and dead caterpillars were found at large in their forest home. . . . (Williams, 1928:166–168.)

Blackburn (1882:55) also described the larva.

***Vanessa virginiensis*** (Drury) (figs. 388, 389, 394, 398, 402).

*Papilio* (Nym[phalis] Gem[mati]) *Cardui Virginiensis* Drury, 1773 (1770): pl. 5, fig. 1, and index (figured in 1770, but not named until index issued in 1773).

*Papilio* (N.G.) *Huntera* Fabricius, 1775:499.

*Vanessa huntera* (Fabricius), Meyrick, 1899:194. Scudder, 1889:457–469, pls. 2, 20, 74, 83, detailed discussion. Perkins, 1913:cliv.

Field, 1938:84, notes.

The painted beauty.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant. A North American species first found in Hawaii by Blackburn (see Tuely, 1878:16, including description of larva).

Hostplant: *Gnaphalium*.

Parasite: *Pterocormus rufiventris* (Bruellé).

Although this butterfly is widespread in the islands, little information has been assembled about it here. Williams (1931:164) notes that the caterpillars come out of their webbed-over nest at sunset to feed.

#### Family DANAIDAE

*Danai* Linnaeus, 1758:458. Fabricius, 1793, preface.

*Danaides* Duponchel, 1832:393. Boisduval, 1833:35; 1840:15.

*Danaidae* Doubleday, 1844:47. Hampson, 1918:366, 385, in part.

*Danaididae* Rebel, 1915:123.

*Euploeinae* Hampson, 1918:385.

#### The Milkweed Butterflies

This group is considered by some workers to be entitled only to subfamily status within the Nymphalidae, and that may be better taxonomy. One of the characters given in many texts to separate the group from the Nymphalidae is that its members are supposed to have bare, unscaled antennae. It is surprising how many times this is noted in literature; yet I have found that the monarch



butterfly does have scales on the antennae, and the scaling is very much the same as that on our *Vanessa tameamea*. Another character used in various texts to separate the two groups is that the danaids have the cell in the hind wing closed, whereas it is said to be open in the Nymphalidae. This may be true for some species, but, as my illustration demonstrates, the cell is closed by a cross-vein in our *Vanessa tameamea*. It is obvious, therefore, that these two supposed distinguishing features are of no value in our fauna. The bare eyes of *Danaus*, however, will serve as a simple and clear-cut character for separating it from the Nymphalidae in the Hawaiian fauna. The males of the Danaidae have a black scent "pouch" on the posterior side of vein two ( $Cu_2$ ) on the hind wings which is not present on the Nymphalidae, and the fore tarsi of the females of Danaidae are terminally clubbed and heavily spined but they are not so formed in the Nymphalidae.

### Genus **DANAUS** (Linnaeus, 1758) Kluk, 1802

**Danaus plexippus** (Linnaeus) (figs. 403, 404, 404-A, 405).

*Papilio Danaus Plexippus* Linnaeus, 1758:471.

*Danaus Archippus* Fabricius, Butler, 1878:185; 1880:6.

*Anosia erippus*, Meyrick, 1899:193.

Field, 1938:127. Corbet, 1949.

For the International Commission for Zoological Nomenclature's decision regarding the name of this species, see Hemming, 1954.

The monarch, milkweed butterfly or wanderer.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Immigrant; an American species which has become very widespread. First seen in Hawaii between 1841 and 1852 soon after its hostplant *Asclepias curassavica* became established here.

Hostplants: *Asclepias curassavica*, *Calotropis gigantea* (crown flower), *Calotropis procera*, *Gomphocarpus physocarpus*.

Parasites: *Brachymeria obscurata* (Walker), *Echthromorpha fuscator* (Fabricius), *Frontina archippivora* (Williston), *Trichogramma minutum* Riley.

The large caterpillars are striking organisms in color and structure. They have a pair of movable, black, soft tentacles near each end of the body (one pair on the mesothorax and the other pair on the eighth abdominal segment), and the body is conspicuously banded segmentally with black, yellow and white rings. The black spiracles are placed in black rings. The pupa is a beautiful greenish structure studded with a line of jewel-like gold dots around the back of the base of the abdomen. For anatomy of larva, pupa and adult, see Scudder (1889) pl. 62, and for extensive details, pp. 720-748. Also see Peterson (1948:176, fig. L33).

The adult is the most conspicuous of our butterflies, and it is common almost everywhere in open country and gardens throughout the year. It is often of pugnacious nature and will sometimes be seen to dash away in pursuit of another

butterfly or a bird. I have often watched them attacking pigeons and doves in my garden and chasing them high into the air and diving on those which settled on utility poles and wires.

F. X. Williams reported seeing a mongoose capture one of these butterflies (*Proc. Hawaiian Ent. Soc.* 12 (1):3, 1944).

The wanderings of the monarch are prodigious and well-known. It flies across entire oceans, and each year specimens which have flown across the Atlantic are seen in England (it is not established there, evidently because of the lack of suitable hostplants). It has become widespread amongst the Pacific islands wherever milkweeds have been introduced. In America, it is a migratory species, and adults hibernate in large swarms in certain places, such as along the coast of middle and southern California.

Scudder (1889:730-731) said "It first reached the Hawaiian Islands . . . sometime not far from 1845 to 1850. At any rate we have the direct statement of Dr. Luther H. Gulick who was born upon the islands, that in 1852 after eleven years' absence, he returned to the islands, and his brother drew attention to the fact that *Asclepias* had been introduced during his absence and had already become a troublesome weed; that his brother had noticed that wherever the milk weed

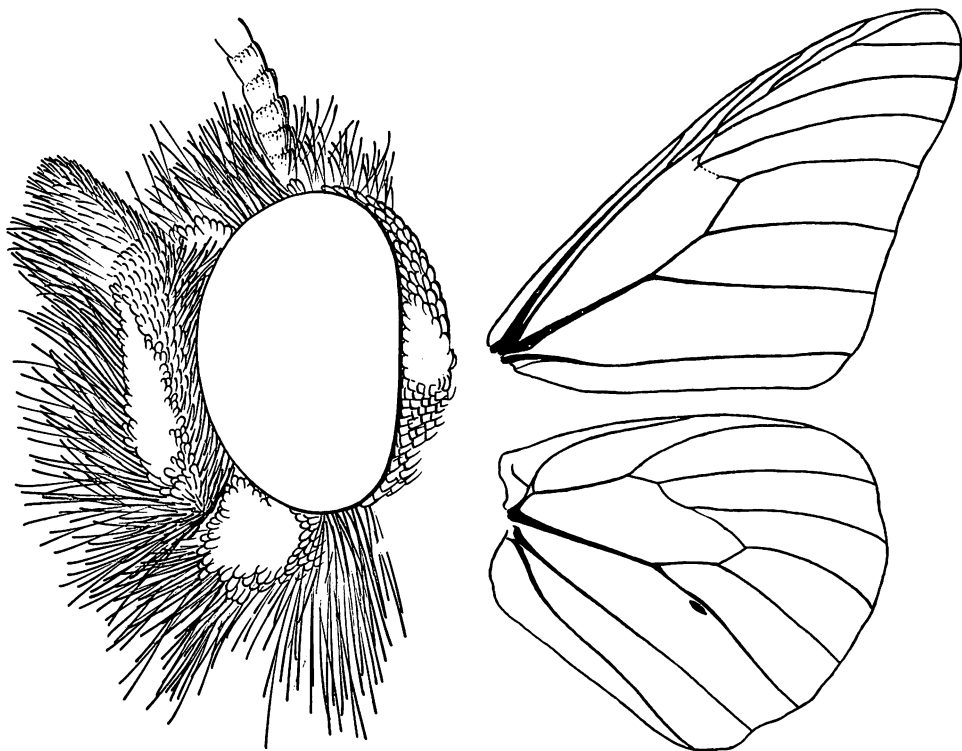


Figure 403—Head (left) and wing venation (right) of *Danaus plexippus* (Linnaeus).

appeared, there also *Anosia* made its advent, a butterfly unknown until after the milk weed had been introduced." Then Scudder gives a discussion of its spread about the islands of the Pacific as well as elsewhere. The interested student is referred for further information to the several American textbooks and articles on this interesting butterfly.

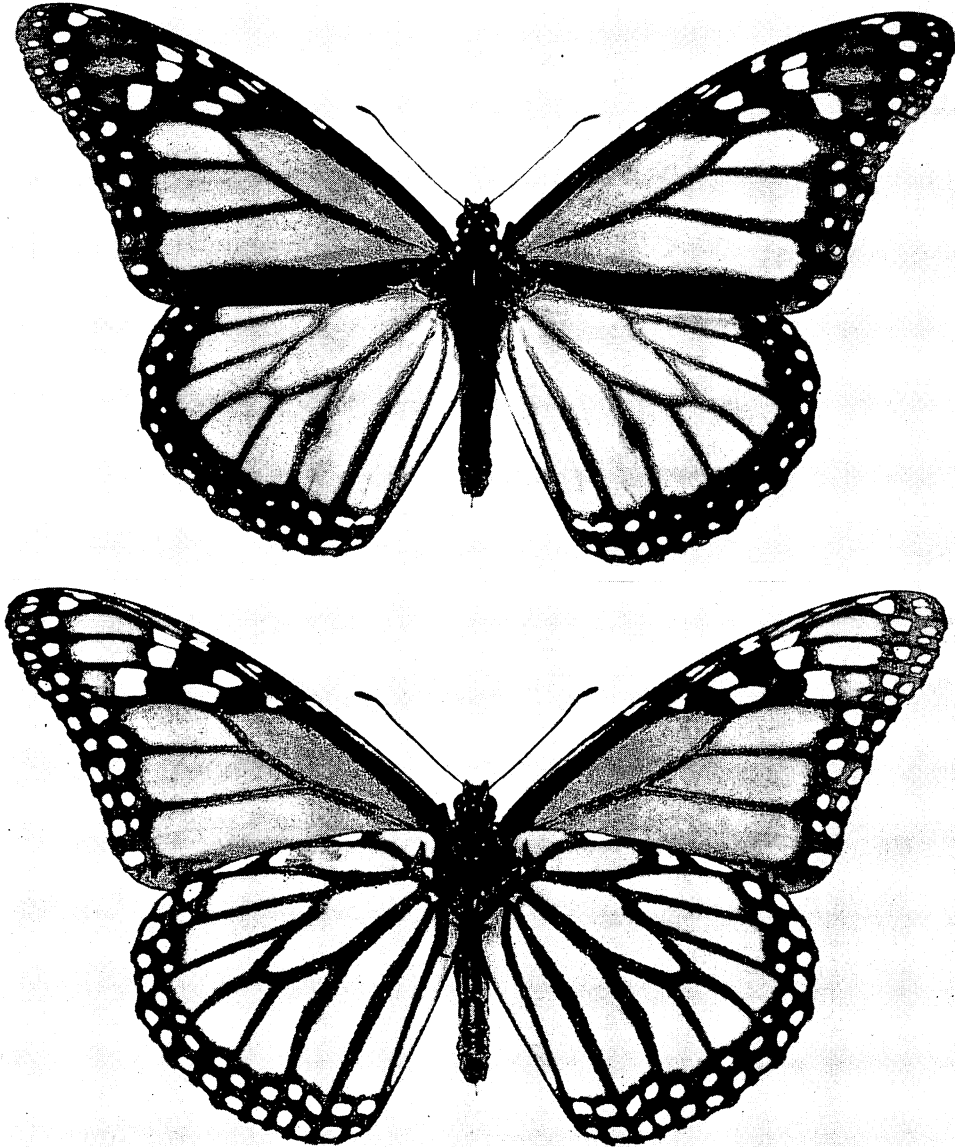


Figure 404—Dorsal and ventral views of a male *Danaus plexippus* (Linnaeus); expanse, 100 mm.; Honolulu.

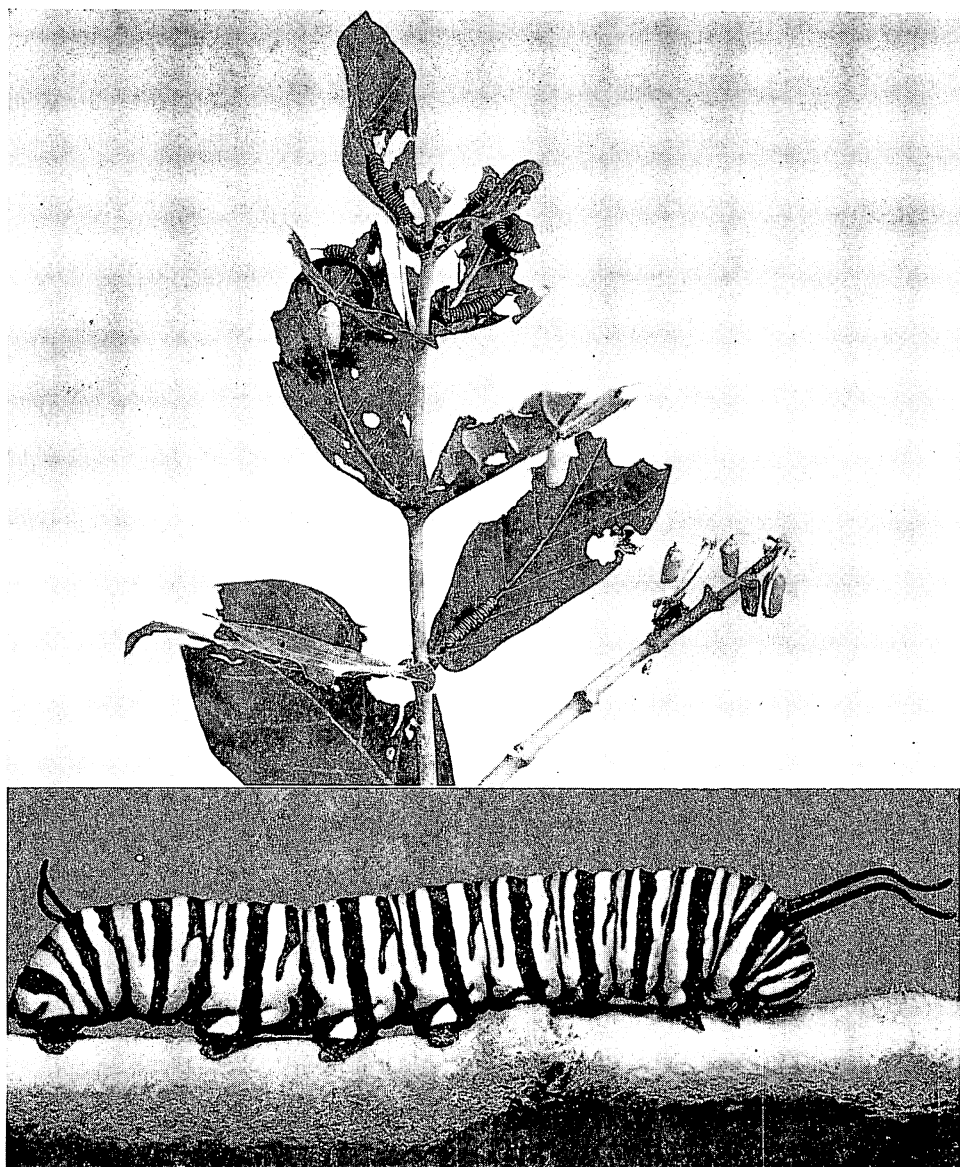


Figure 404-A—*Danaus plexippus* (Linnaeus). At the top is part of an *Asclepias* plant showing typical damage, larvae and pupae. A mature larva is at the bottom.

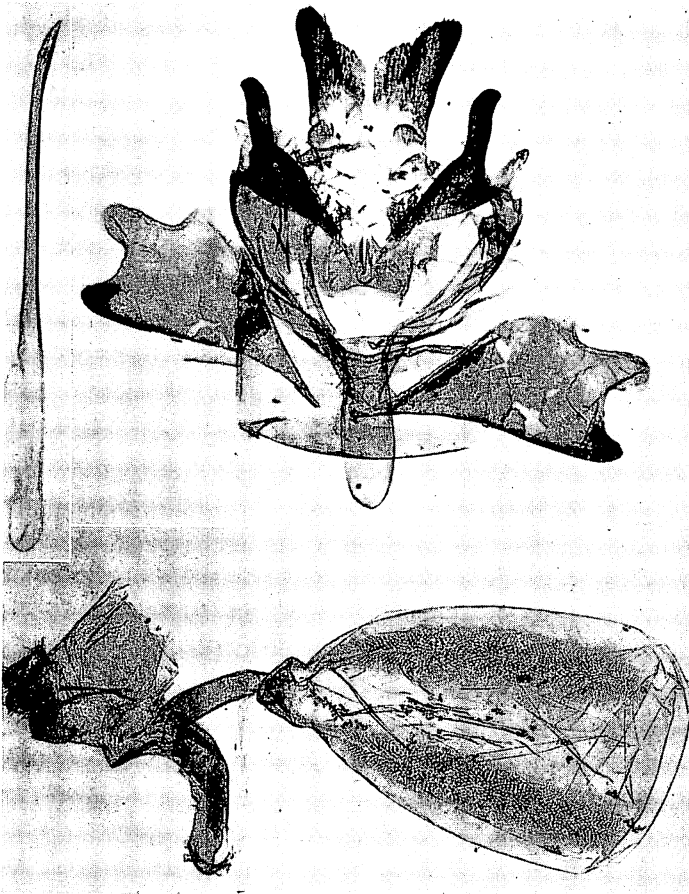


Figure 405—Male (above) and female (below) genitalia of *Danaus plexippus* (Linnaeus); Honolulu.

#### Family LYCAENIDAE

*Plebeji* Linnaeus, 1758:458.

*Lycaenida* Leach, 1815:129.

*Lycaenides* Duponchel, 1832:387. Boisduval, 1833:23; 1840:8.

*Cupidinidae* Hampson, 1918:385.

#### The Blues, Hairstreaks, Coppers and Allies

This is a large family which contains some of the world's most beautiful insects. It is represented in Hawaii by one endemic species and three foreign species which may be separated by the following key:

SIMPLIFIED KEY TO THE SPECIES OF LYCAENIDAE IN HAWAII

- 1. Hind wing with threadlike "tails" .....2  
Hind wing without "tails" .....3
- 2. Hind wings each with only one tail; under side of both pairs of wings with numerous, transverse, compound, wavy-appearing, white lines on a brown background; with a little orange scaling on under side only around the eyespots at the base of the tail on hind wing; fore wing with 11 veins.....**Lampides boeticus** (Linnaeus).  
Hind wings each with a long and a short tail (the latter may be very small); under side of hind wings with only two series of marks between base and two-thirds, and these mostly broken up into orange spots; fore wing without any bands or spots basad of middle, but with an orange band beyond middle; fore wing with only 10 veins.....  
.....**Strymon echion** (Linnaeus).
- 3. Fore wings fuscous or brownish above; hind wings blue above except at base and with distinct dark spots in the blue field near apical margin; under sides of both pairs of wings obviously marked with brown and white lines and spots and without any green scaling; fore wing with only 10 veins.....**Strymon bazochii gundlachianus** (Bates).  
Wings not spotted or lined on either surface; lower surface with striking and extensive green scaling; fore wings with 11 veins.....**Vaga blackburni** (Tuely).

Subfamily THECLINAE

Genus **STRYMON** Huebner, 1818:22

**Strymon bazochii gundlachianus** (Bates) (figs. 407, 408, 411, 412).  
*Strymon gundlachianus* Bates, 1935:195, type from Cuba.  
Swezey, 1924:74, fig. 1e.

The smaller lantana butterfly.  
Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.  
Purposely introduced from Mexico in 1902 by Koebele to aid in the control of *Lantana*.  
Hostplants: feeds in the flower heads of basil, *Hyptis pectinata*, *Lantana*.  
Parasite: *Trichogramma minutum* Riley (parasitism of the eggs sometimes very high).  
Predator: *Pheidole megacephala* (Fabricius) destroys the eggs.  
This butterfly was introduced with *Strymon echion* in the fight against lantana. It is smaller than *echion*, it lacks tails on the hind wings, the lower surfaces

of the wings are marked with brown and white and lack the orange marks of *echion*, the upper surfaces of the fore wings are brownish (the male has a large, darker brown macula which is absent in the female), and the hind wings are mostly pale blue.

For many years this species has appeared in Hawaiian literature under the name *Thecla agra* Hewitson, or *Thecla bazochi* or *bazochii*, or *Callicista thijs* Huebner.

Swezey (1924:74) figured the larva, which he described as

about 12 mm. long by 3 mm. wide . . . dull leaf green; covered with short white bristles and longer dark bristles; head testaceous, eyes black; spiracles circular, pale, slightly darker outlined.

He described the pupa as follows:

The chrysalis is brownish fuscus; 8 mm. long, 4 mm. wide, and 3 mm. high. It is fastened to the surface of leaf or other object with loose silk fibers; not flattish on under surface like *Thecla echion*; upper surface with white hairs, larger and longer than the pubescence of *T. echion*. A larva became full grown and pupated 19 days from hatching, and the butterfly appeared in 14 days from pupating. Others were from 10 days to 14 days in the pupa stage. Thus it is about five weeks or less from hatching to maturity, practically the same as with *T. echion*.

He also notes that: Several times in the regions where the butterflies are seen abundantly, I have found nearly every lantana flower cluster examined to contain either a butterfly larva or one or more of their eggs. They are to be considered very important factors in the prevention of lantana fruits, for each larva will feed on one or more flower clusters and scarcely leave any flowers to produce seeds.

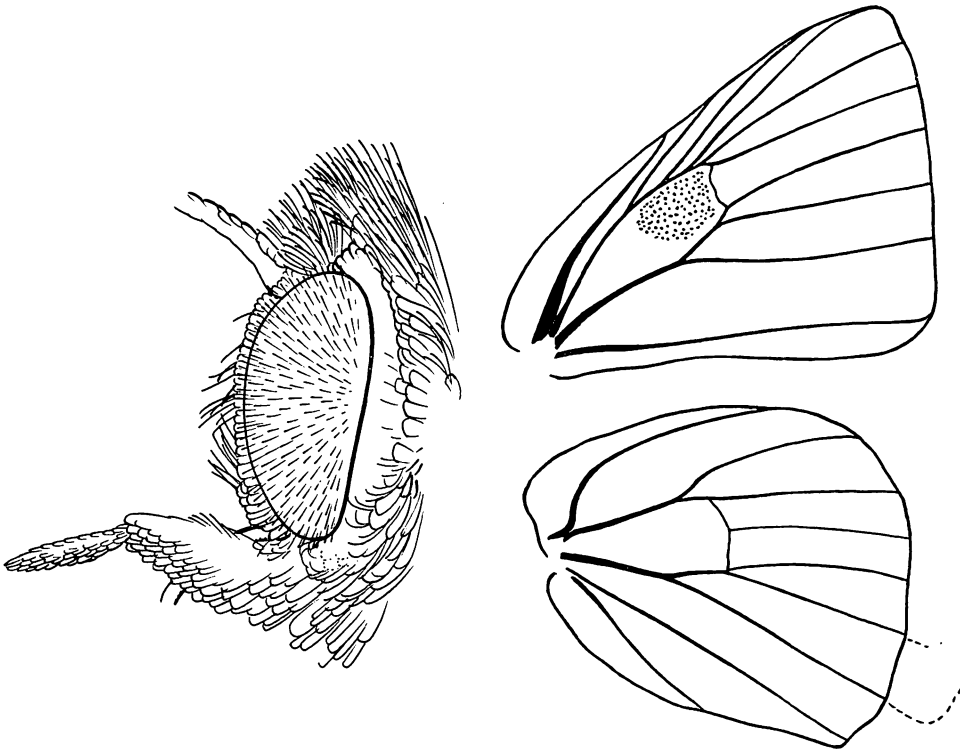


Figure 406—Head (left) and wing venation (right) of *Strymon echion* (Linnaeus).

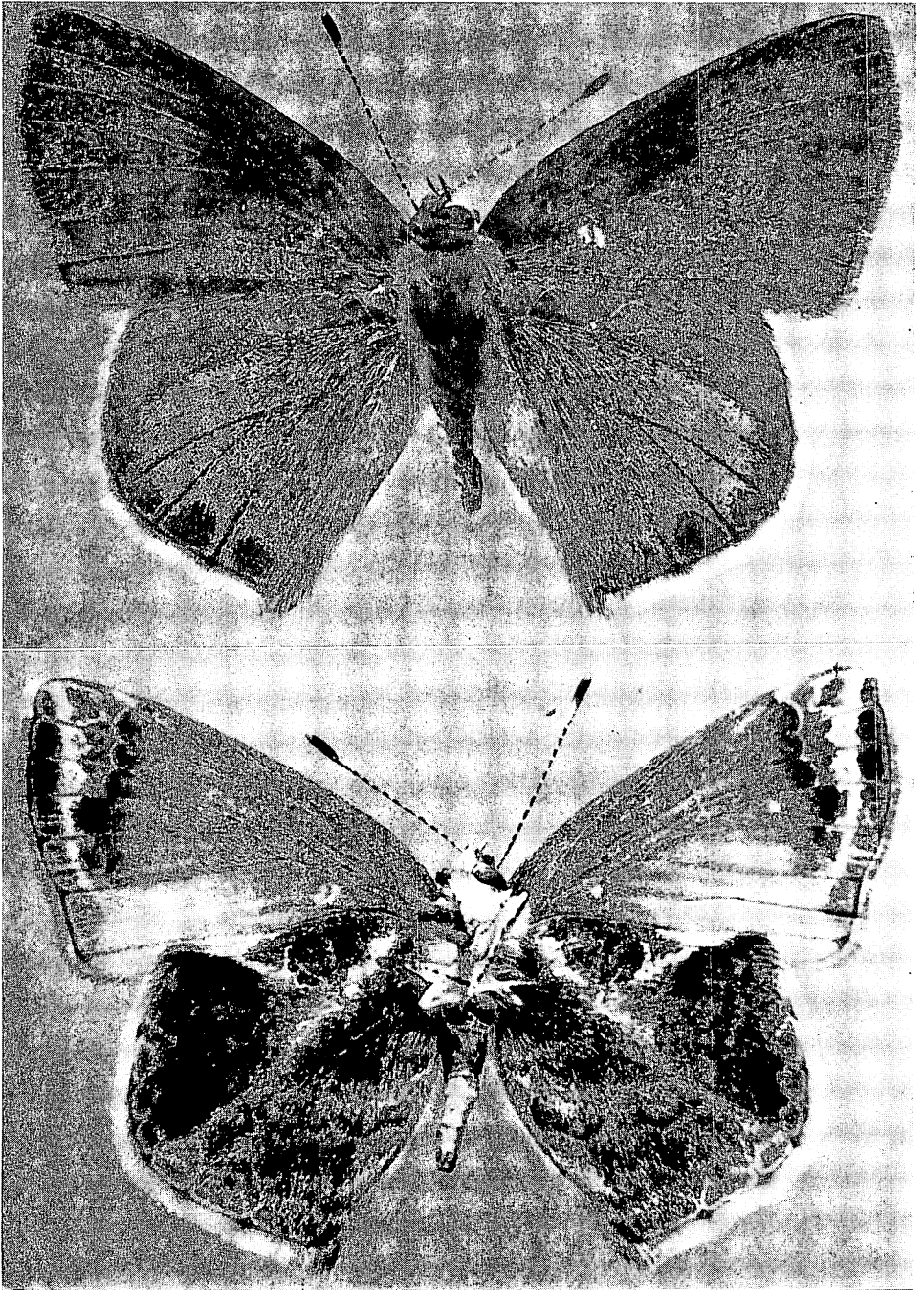


Figure 407—Dorsal and ventral views of a male *Strymon bazochii gundlachianus* (Bates); expanse, 25 mm.; Koko Head, Oahu. Reared from basil.



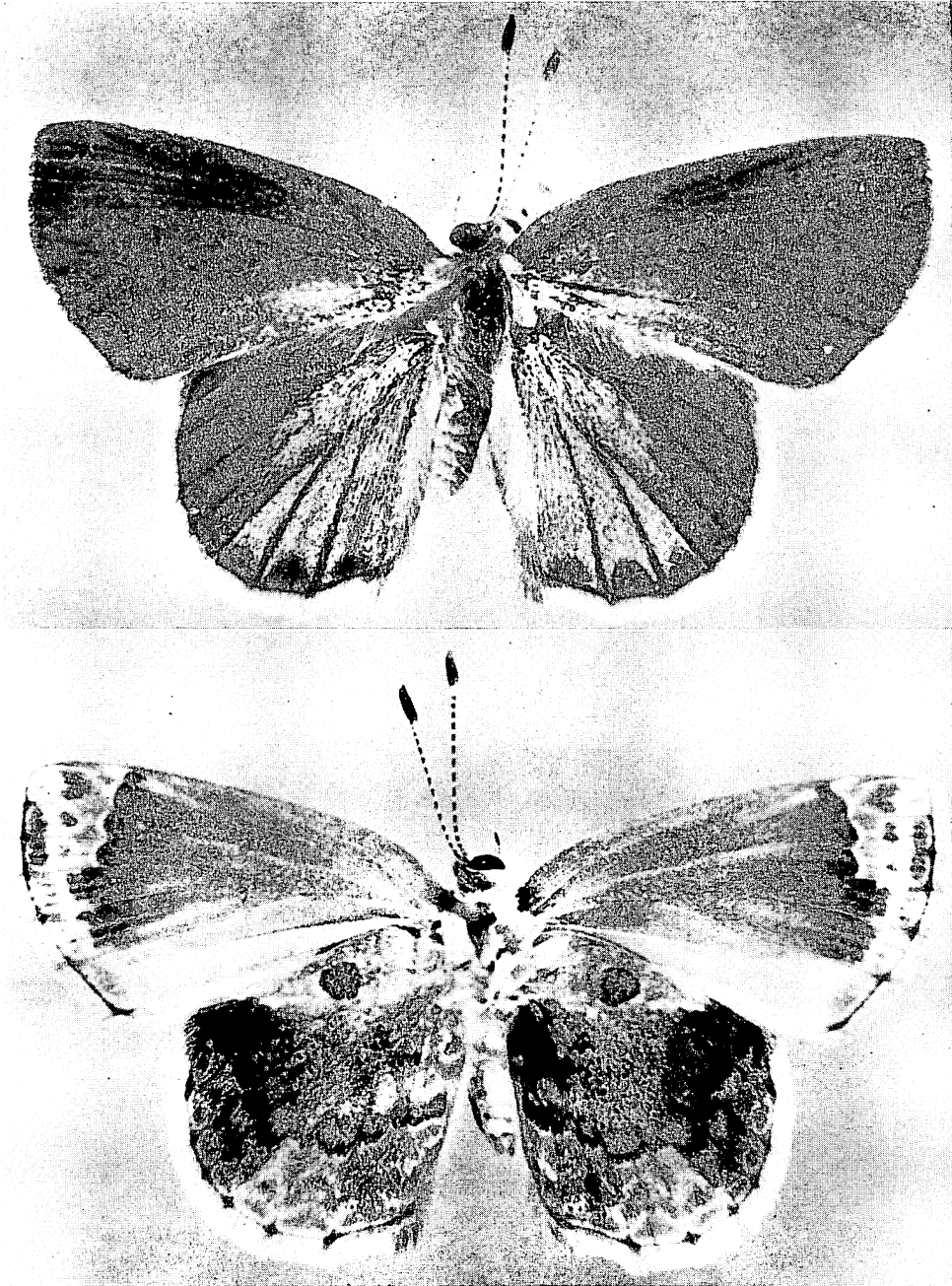


Figure 408—Dorsal and ventral views of a female *Strymon bazochii gundlachianus* (Bates); expanse, 23 mm.; Honolulu. Reared from *Hyptis pectinala*.

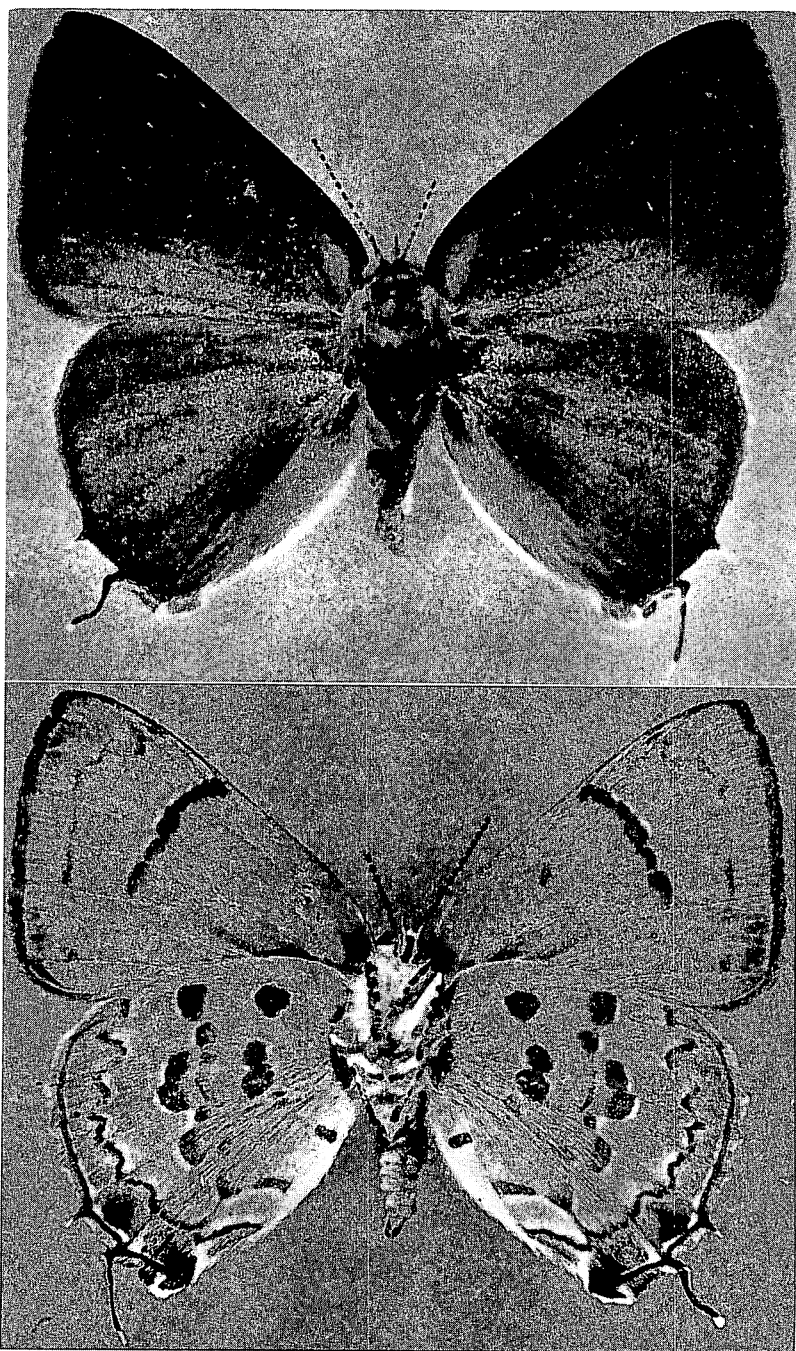


Figure 409—Dorsal and ventral views of a male *Strymon echion* (Linnaeus); expanse, 27 mm.; Waipio, Oahu. Reared from eggplant flowers.

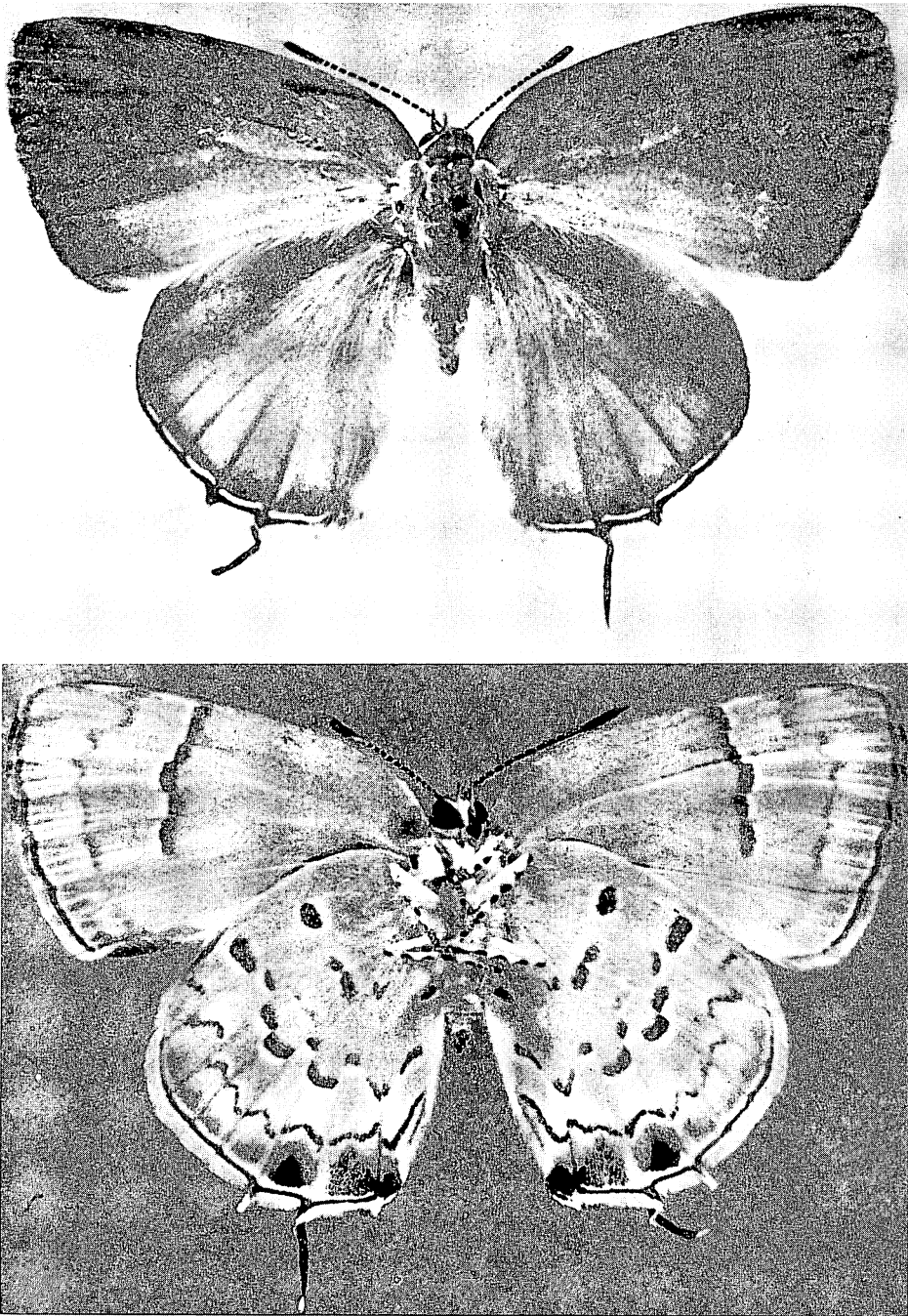


Figure 410—Dorsal and ventral views of a female *Strymon echion* (Linnaeus); expanse, 29 mm.; Oahu. Reared from *Solanum nodiflorum*.

**Strymon echion** (Linnaeus) (figs. 406, 409, 410, 411, 413).

*Papilio Plebejus Echion* Linnaeus, 1767:788.

*Thecla echion* (Linnaeus), Swezey, 1924:73-74, figs. 1a-c.

The larger lantana butterfly.

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii.

Purposely introduced by Koebele from Mexico in 1902 to aid in the control of *Lantana*.

Hostplants: Bull-nosed pepper, chili pepper, *Cordia sebestina* (pods and seeds),



Figure 411—Above: Male genitalia of *Strymon bazochii gundlachianus* (Bates); Honolulu. Below: *Strymon echion* (Linnaeus); Honolulu.

*Datura arborea*, eggplant (leaves and fruit), *Lantana* (flowers), pepper, *Solanum nodiflorum* (green fruit), *Solanum sanitwongsei* (green fruit), potato.

Parasites: *Trichogramma minutum* Riley, in the eggs.

Predator: *Pheidole megacephala* (Fabricius) feeds on the eggs.

This is the larger of the two blue butterflies introduced to aid in the control of the lantana pest. It is easily distinguished from the foregoing species of *Strymon*

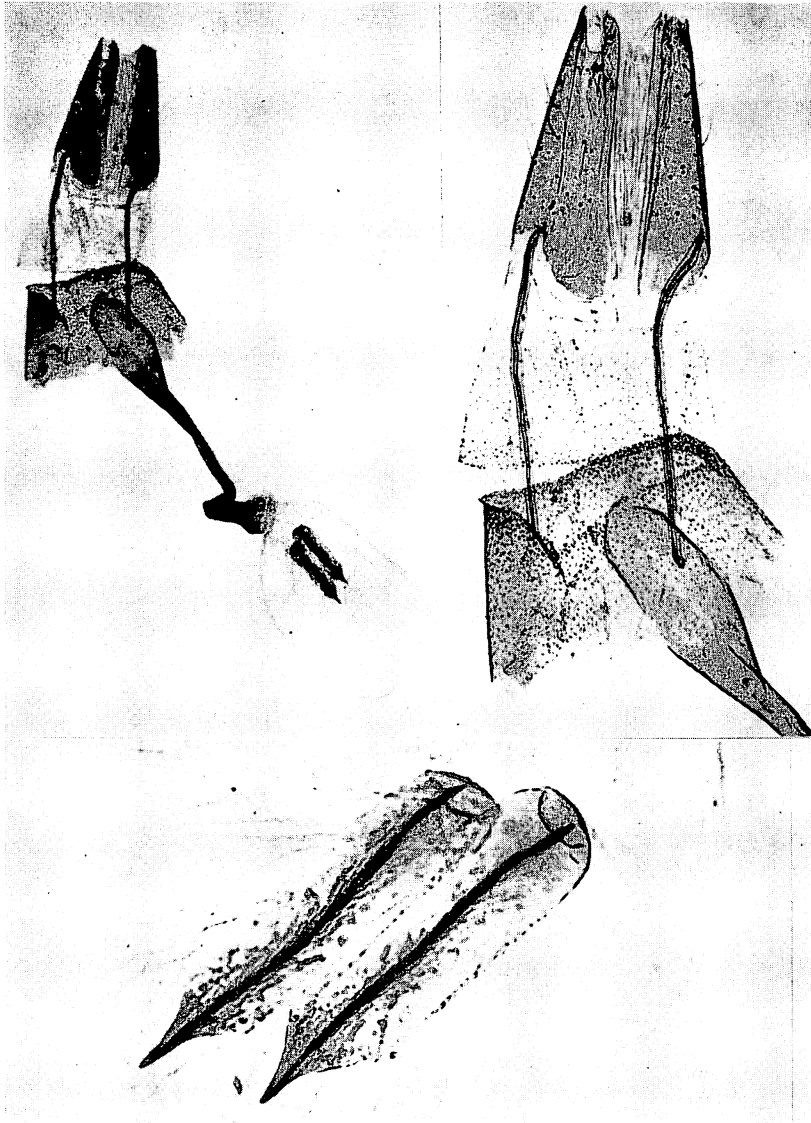


Figure 412—Female genitalia of *Strymon bazochii gundlachianus* (Bates); Honolulu.



because it has no tails on the hind wings, and the under sides of the wings are marked with lines of orange spots (this orange coloration will separate the species from all of our other lycaenids).

Attention may be called to the fact that although this species was purposely introduced to control lantana, it also attacks a number of garden crops.

The egg is white, becoming greenish when near the time of hatching; a little more than half a millimeter in diameter; somewhat hemispherical, with the flattish side attached to the plant surface; surface thimble-like, roughened with a regular reticulation of raised ridges bearing points at the intersections.

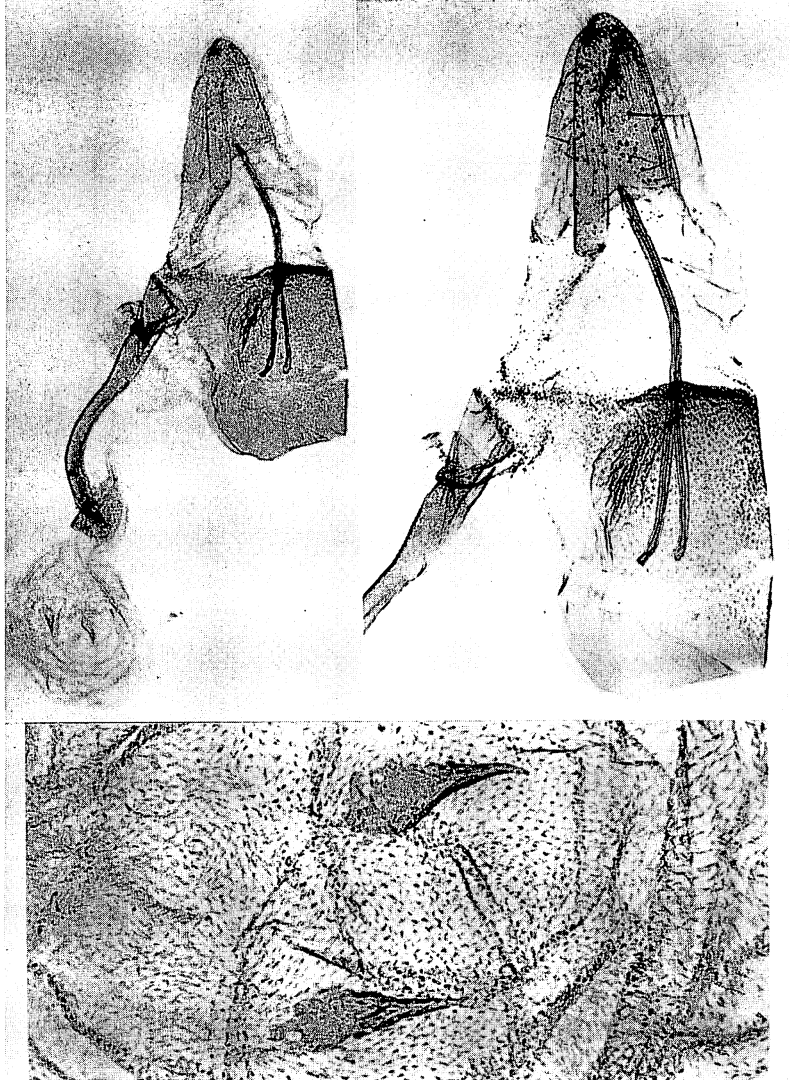


Figure 413—Female genitalia of *Strymon echion* (Linnaeus); Honolulu.

On hatching, the tiny larvae often burrow into the tube of the flower, and as they increase in size feed on the flowers of the cluster, often eating all and migrating to other clusters. Thus one larva may be responsible for destroying the flowers of several clusters and preventing them from producing any berries. They sometimes eat the green berries also.

The full-grown larva of *Thecla echion* is about 12 mm. long and 3 mm. wide in the thickest place. The sides very slightly crenate by the segmental constrictions. Color, light leaf green. Surface covered with short white bristles. Head testaceous, eyes black. Spiracles circular, black.

The chrysalis is about 10 mm. long, 4.5 mm. wide, and 4 mm. high. It is fastened at posterior end to the surface of leaf or other object, and held in position by a silken loop over the back. It is flattish on the under side, quite evenly curved above, brownish fuscous, upper surface covered with short, fine, pale brownish hairs or pubescence. In breeding jar the chrysalids were found on the surface of leaves on the bottom of the jar. Probably in the open they are made on the surface of fallen leaves or among debris on the ground, but they have not yet been found.

A larva obtained its growth and pupated in 21 days from the hatching of the egg. With a number of specimens the pupal stage was 13 to 14 days. Thus it is five weeks from hatching of egg to the maturing of the butterfly. There could be six or seven broods a year. (Swezey, 1924:73-74.)

### Subfamily LYCAENINAE

#### Genus **LAMPIDES** Huebner, 1819

**Lampides boeticus** (Linnaeus) (figs. 414, 415, 416, 417).

*Papilio Plebejus boeticus* Linnaeus, 1767:789.

*Polyommatus boeticus* (Linnaeus), Butler, 1882:31.

*Lycaena baetica* (Linnaeus), Meyrick, 1899:195.

*Lycaena boetica* (Linnaeus), Perkins, 1913:clvi.

*Lampides boeticus* (Linnaeus), Corbet, 1948:596; 1956:293, pl. 10, fig. 148, pl. 45, fig. 167.

*Cosmolyce boeticus* (Linnaeus), of authors.

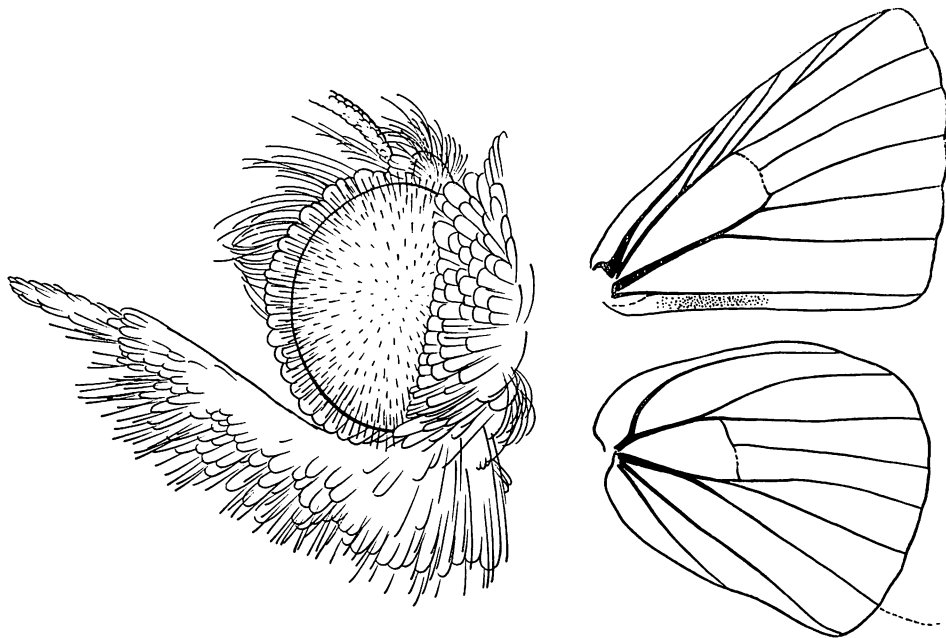


Figure 414—Head (left) and wing venation (right) of *Lampides boeticus* (Linnaeus).

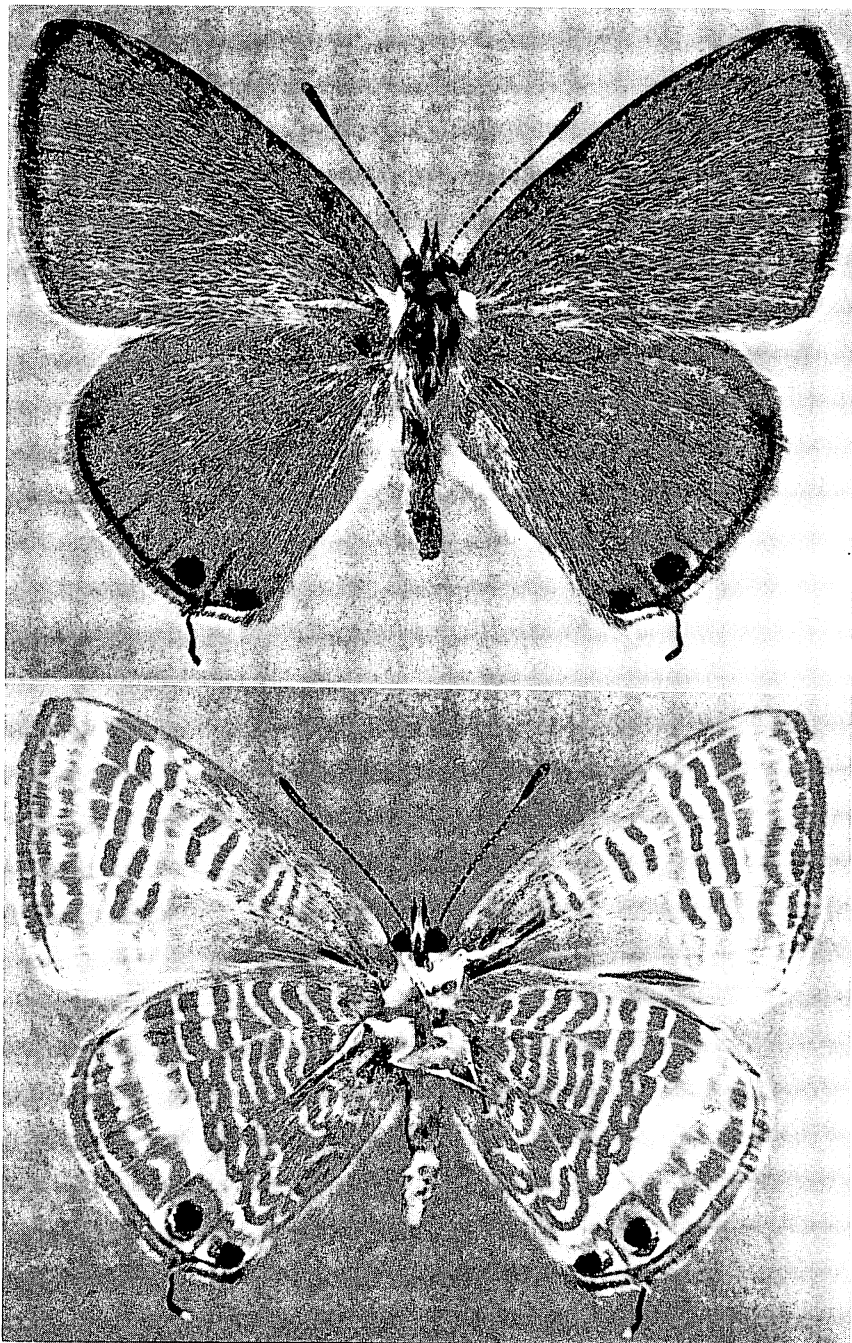


Figure 415—Dorsal and ventral views of a male *Lampides boeticus* (Linnaeus); expanse, 30 mm.; Mapulehu, Molokai. Reared from *Crotalaria*.



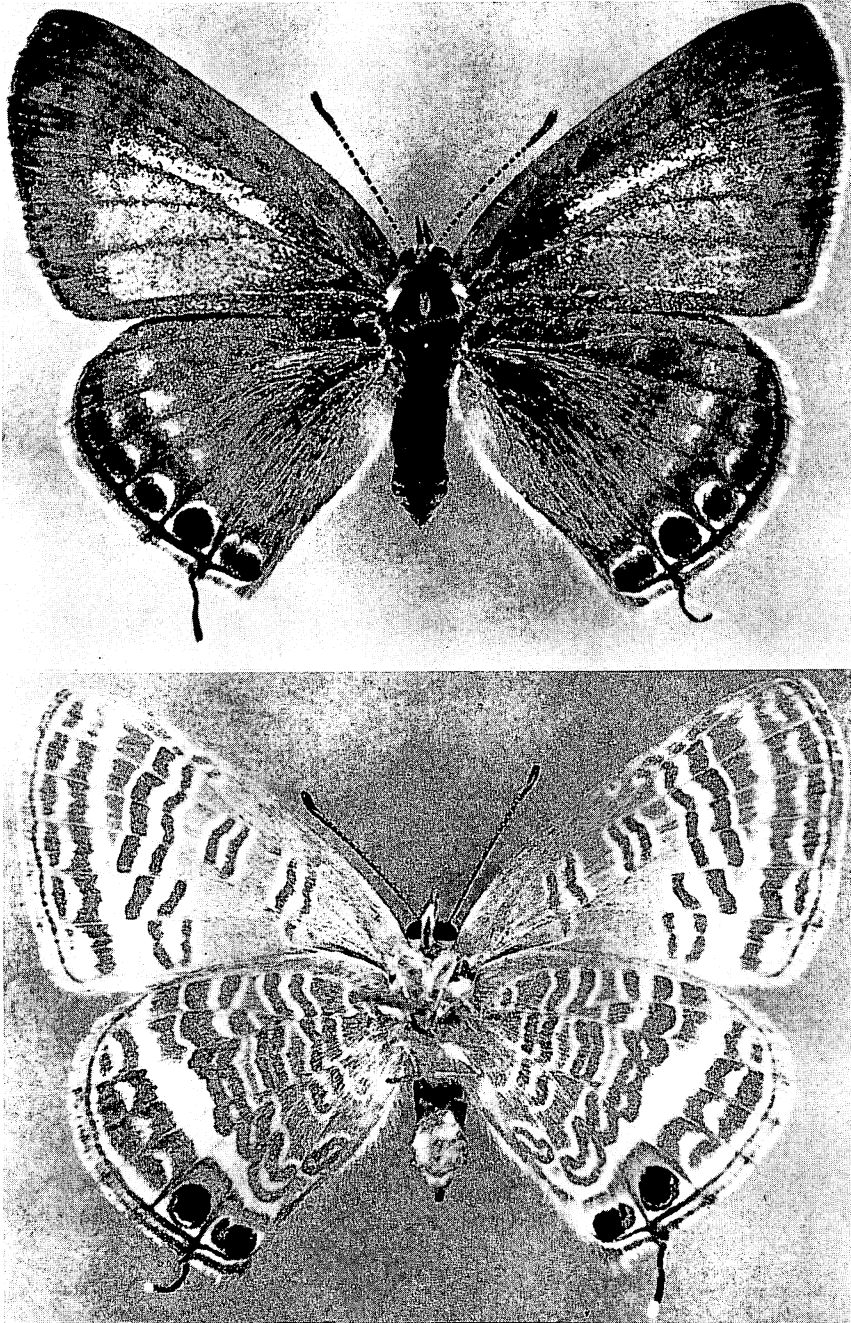


Figure 416—Dorsal and ventral views of a female *Lampides boeticus* (Linnaeus); expanse, 33 mm.; Mapulehu, Molokai. Reared from *Crotalaria*.

The bean butterfly (known as the "long-tailed blue" in England).

Kauai, Oahu, Molokai, Maui, Lanai, Hawaii, Necker.

Immigrant. Widespread from Africa, southern Europe to India and the Orient to Malaya and Australia. First taken in Hawaii by Blackburn before 1882.

Hostplants: Broad bean, *Crotalaria saltiana*, *Crotalaria* species, garden bean, garden pea, *Gliricidia sepium*, hyacinth bean, lima bean, pigeon pea, *Sesbania tomentosa*, *Sophora chrysophylla*, *Ulex europaeus* (gorse).

Parasites: *Frontina archippivora* (Williston), *Pentarthron flavum* Perkins, *Trichogramma minutum* Riley.

Predator: *Pheidole megacephala* (Fabricius) feeds upon the eggs and larvae.

This pest of beans is one of the commonest butterflies in Hawaii, and it is the common blue butterfly of gardens and lowland fields. Its caterpillars destroy the flowers of the host as well as eating into the pods and destroying the developing beans. It may be a pest of importance to garden beans, and, if not controlled, considerable damage may on occasion occur.

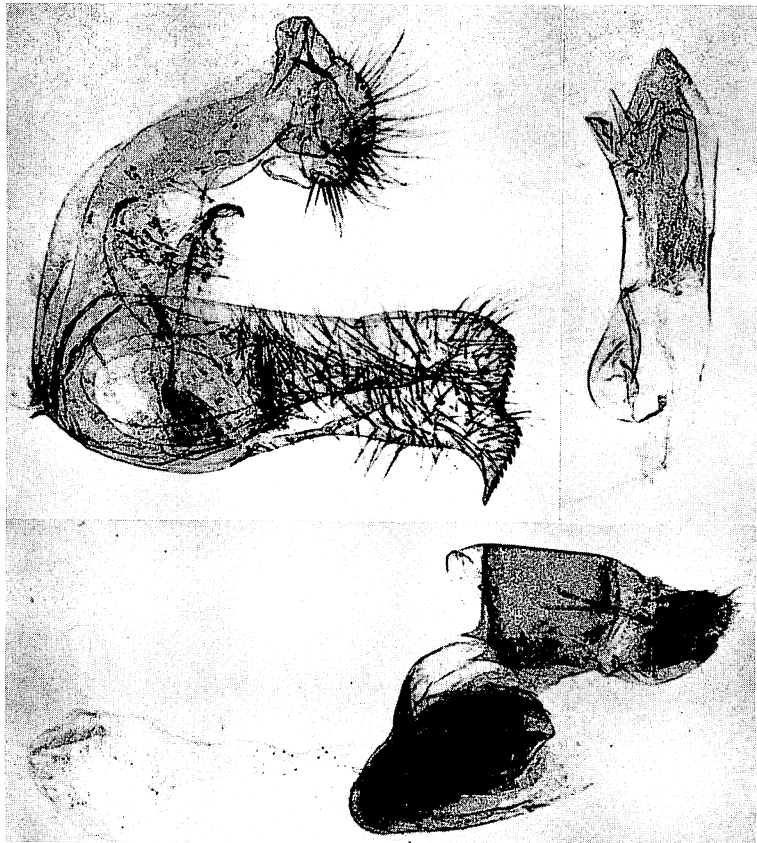


Figure 417—Male (above) and female (below) genitalia of *Lampides boeticus* (Linnaeus); Honolulu.

The upper surface of the male is almost entirely pale blue; the female has the wings outwardly infuscated. Each hind wing bears a long, fragile, thread-like tail. The prominent markings of the under side of the wings consist of sinuous white lines on a pale brown background. At the base of the tail on both surfaces of the wing is a pair of black maculae, and the dark spots are surrounded with orange scales on the under side.

The caterpillar has short, fine, dense body setae; the spiracles are pale and inconspicuous. Additional information on the larvae was assembled by Blackburn and published by Butler (1882:32).

Genus **VAGA**, new genus

The only native Hawaiian lycaenid has never correctly been placed taxonomically. It has wandered in literature from *Holochila* to *Lycaena* to *Candalides*, where it has remained for many years. It is still called a *Lycaena* in Hawaii. There appears to be no described genus to which it can be assigned, however, and a new genus must, unfortunately, be characterized to receive it, as follows:

Superficially appearing somewhat intermediate between *Lycaenopsis* and *Candalides*. Head, in side view, as illustrated; eyes setose; palpi fringed beneath with

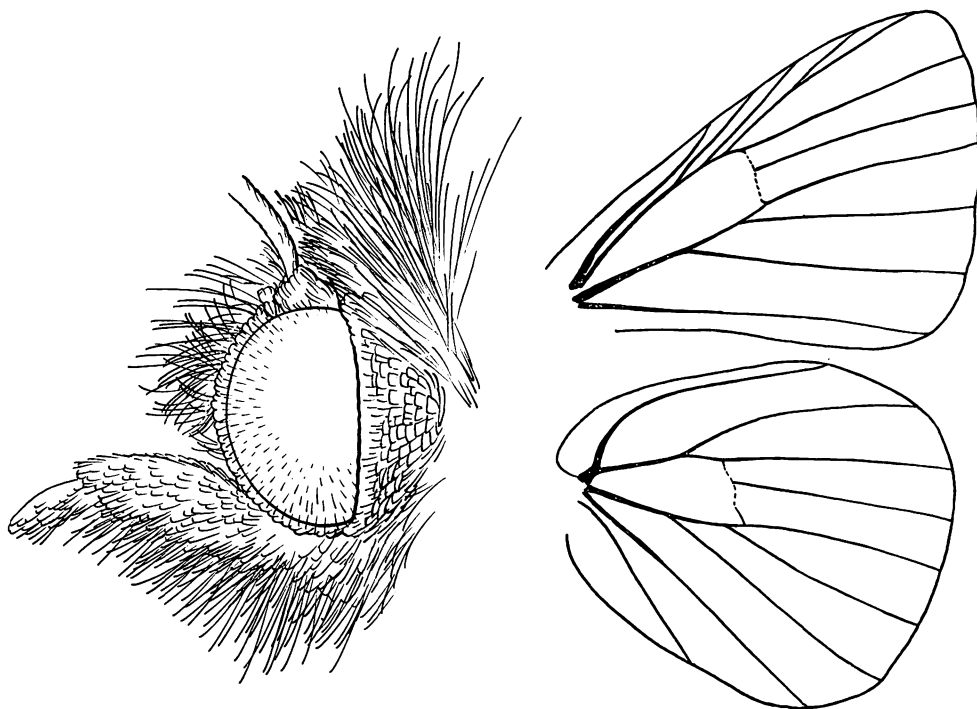


Figure 418—Head (left) and wing venation (right) of *Vaga blackburni* (Tuely).

long hair; front with long hair. Front coxae and tibiae with much long hair. Wing venation as illustrated; tails and androconia absent; spotting on upper and lower surfaces of both pairs of wings slight or obsolete. Male and female genitalia as illustrated.

The genitalia appear closest to *Lycaenopsis*, as represented by *haraldus* (Fabricius), the type of that genus. The included species do not, however, bear any

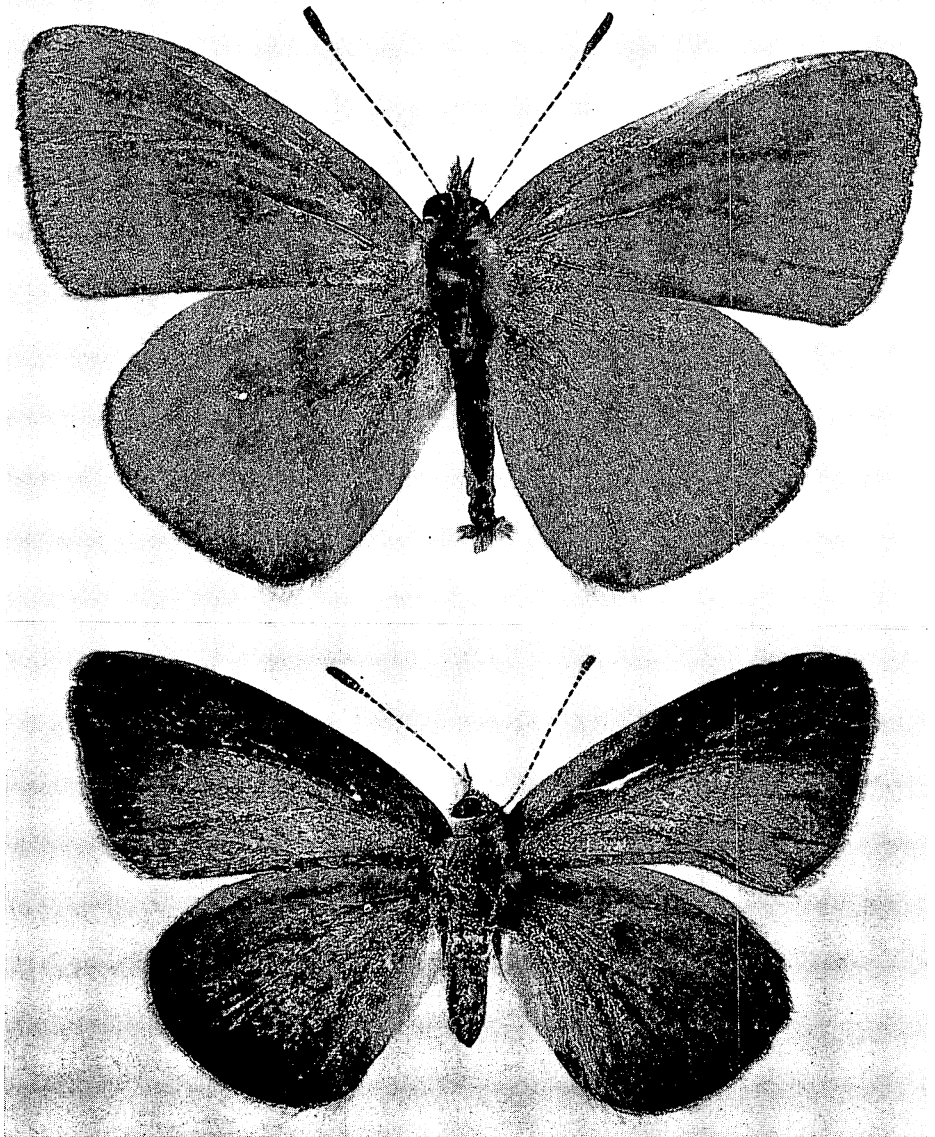


Figure 419—Dorsal views of *Vaga blackburni* (Tuely); Oahu. Male, above; female, below.

superficial resemblance to *Lycaenopsis haraldus*, which has very different color and pattern and has the under sides of the wings strongly maculate. Also, *haraldus* has bare eyes, and the palpi are smooth-scaled, lack long hair and are distinctive in type. The upper surface of *Vaga blackburni* somewhat superficially resembles *Candalides heathi* (Cox), from western Australia, and in some collections it is placed next to *heathi*. However, the genitalia of *heathi* are generically very different, and *heathi* has bare eyes.

Type of *Vaga*: *Holochila blackburni* Tuely. The gender of *Vaga* is feminine.

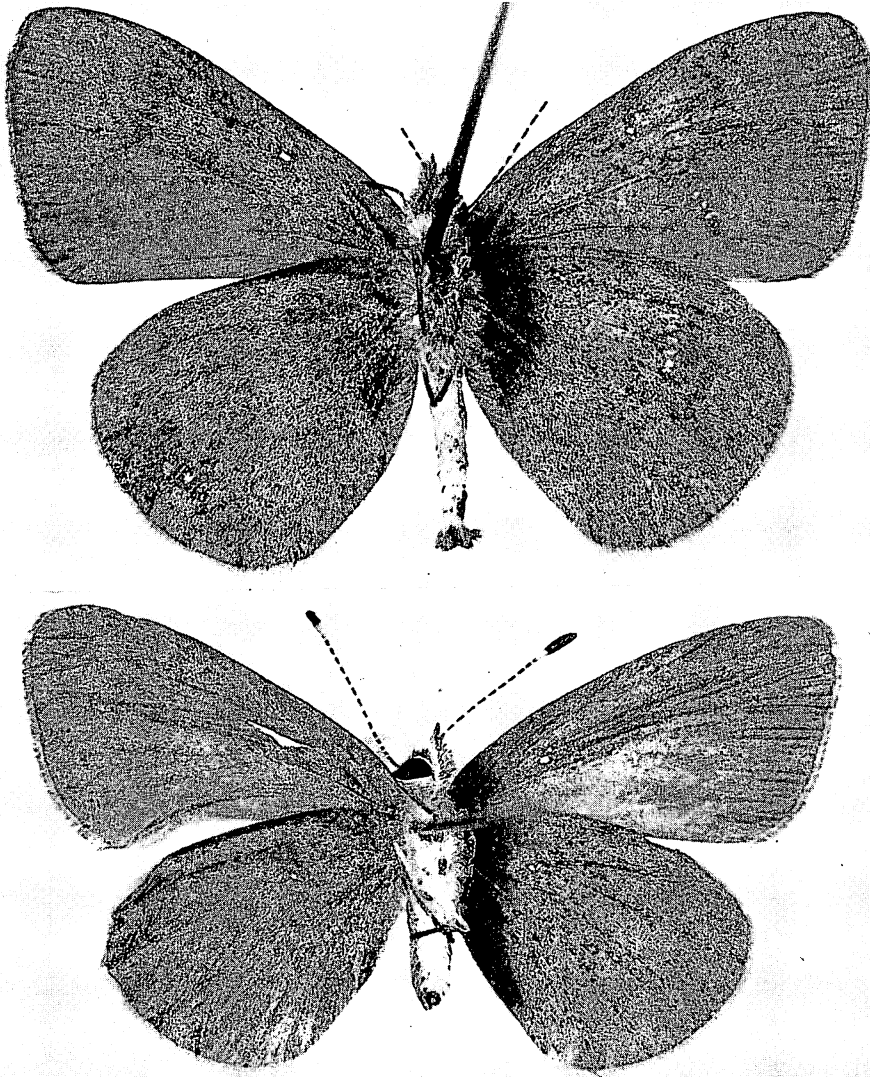


Figure 420—Ventral views of *Vaga blackburni* (Tuely); Oahu. Male, above; female, below.

It is now of great interest also to assign *Lycaena* (?) *ogasawaraensis* Pryer, 1886:10, pl. 2, fig. 10, from the Bonin Islands to the new genus. It is possible that *blackburni* is a derivative of *ogasawaraensis*, or that they are descended from a common stock, and the original ancestors which populated Hawaii may have come from the Bonin Islands. *Vaga ogasawaraensis* (Pryer), **new combination**, has green scaling on the under sides of the hind wings. The under sides of both pairs of wings of *blackburni* have the green scaling extended and intensified, and it is a very striking and unusual green which immediately enables the species to be recognized. The upper sides of the wings of both species are unspotted. *Vaga ogasawaraensis* has some feebly developed spots on the under sides, but all spotting has been lost on *blackburni*. The genitalia display excellent specific differences. The apices of the valves, for example, are each drawn out into a sharp process on *ogasawaraensis*, but they are conspicuously different on *blackburni* (see the illus-

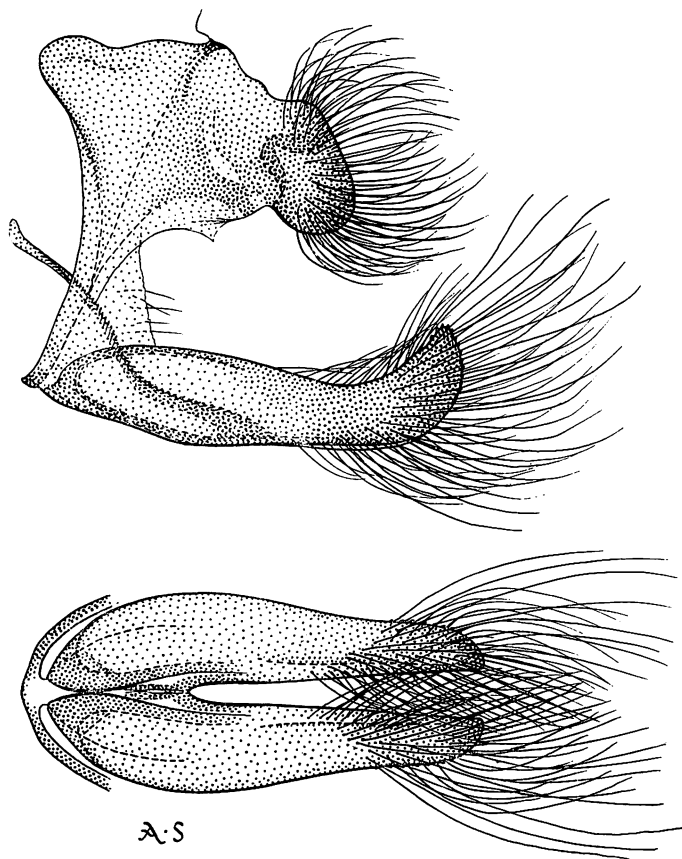


Figure 421—Lateral (above) and ventral (below) views of the male genitalia of *Vaga blackburni* (Tuely), aedeagus removed.

tration). At first sight, one might almost be led to consider the male genitalia to be of different types in the two species, but careful study will reveal the basic similarity.

It is difficult to form opinions of the limits and distribution of *Candalides* and *Lycaenopsis* from the literature, but they are Indonesian and Australian genera. Mr. Bennett and I have examined a number of species of *Lycaenopsis* Felder and Felder, 1865:257, rather widespread in Indo-Malaya (see Chapman, 1909, and Fruhstorfer, 1916, for revisional studies, although misleading), and *Candalides* Huebner, [1819]:73, type *xanthospilos* Huebner, southwest Australia, and it is obvious that the genera are composite and require careful and major revision in the light of modern knowledge and techniques.

**Vaga blackburni** (Tuely), **new combination** (figs. 418, 419, 420, 421, 422, 423).

*Holochila Blackburni* Tuely, 1878:9. Blackburn, 1882:56, larva.

*Lycaena blackburni* (Tuely) Meyrick, 1899:194, pl. 5, fig. 10. Perkins, 1913:clvi.

*Candalides blackburni* (Tuely) Gruenberg, in Seitz, 1922:856.

Blackburn's butterfly.

Endemic. Kauai, Oahu (type locality: probably upper Nuuanu Valley), Molokai, Maui, Lanai, Hawaii.

Hostplants: *Acacia koa* (principal host), *Acacia* species (on occasion), *Dodonaea viscosa*, *Kadua*, *Perrottetia sandwicensis* (reared from young leaves on one occasion), *Pipturus*, *Pithecolobium*, *Samanea saman*.

Parasites: I have no records of any parasites of this species.

Although this fine little butterfly is a denizen of the native forests, it is frequently blown into the lowlands and is often seen about gardens in the city. Its most usual hostplant is koa, and it is often found on *Dodonaea* in the mountains. It may on occasion, however, breed on several other plants and may feed upon various introduced leguminous trees in the lowlands.

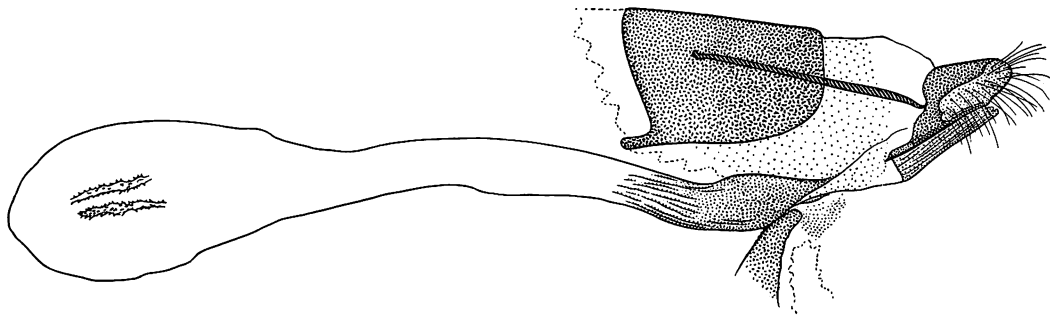


Figure 422—Female genitalia of *Vaga blackburni* (Tuely).

The under sides of the wings of both sexes are nearly uniformly clothed with beautiful green scales, except for the posterior part of the fore wing where it overlaps the hind wing. There are no spots on either surface of the wings. The sexes are easily told apart, because the upper surfaces of the fore wings of the male are suffused over-all with purple-blue (which is especially striking if the specimen is shifted from side to side in the light), but the female has paler blue confined to the discal areas of the fore wings with the remainder dark. Also, the thorax of the female is clothed with a conspicuous abundance of green scales over the entire dorsum, but the green scales are absent or almost absent from the thorax of the male.

I made the following observations on some larvae which I captured on *Acacia koa* on Mt. Tantalus, Honolulu: The caterpillars are so wonderfully camouflaged that it is very difficult to find them on the blossoms of the koa. Even a careful search of the blossoms may fail to reveal them, but some may be dislodged by beating, and by bringing bunches of the blossoming stems into the laboratory one

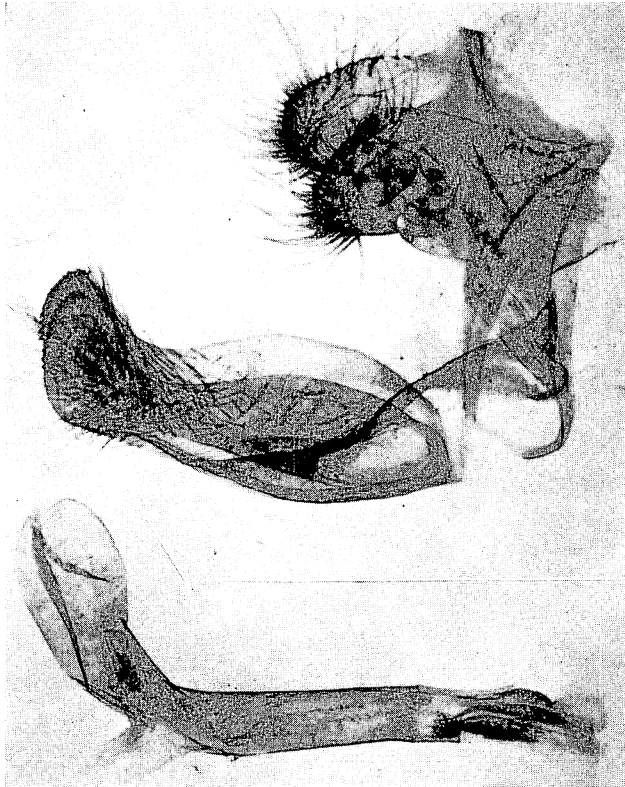


Figure 423—Male genitalia of *Vaga blackburni* (Tuely); Halemano, Kauai.

NOTE: The correct number of cuts should be 425 (two are numbered "A"), and they contain about 1,110 individual photographs and drawings.



may more easily locate the caterpillars by watching for frass pellets beneath the inhabited blossoms and then searching the blossoms immediately above the frass which has fallen to the table top. The young larvae are mostly green; later they become more yellow-green, and they match perfectly the yellow ball-like blossom heads of the koa. Some mature larvae may become largely delicate orange-brown with a darker medial, dorsal stripe, and these match the brownish-streaked branchlets. When moving about the larvae lay out "life lines" of silk from their oral spinnerets. The lateral and dorsal surfaces are densely clothed with conspicuous, star-like asperities out of the middle of each of which arises an erect seta. These asperities are mostly paler than the derm color, but some may be black, and there may be areas in which the black asperities are condensed, and the black ones may be scattered over the entire dorsal surface. The spiracles are distinct and pale. The arrangement of the pale and dark coloration, augmented by the asperities, produces a diagonal or echelon-like striping on each side from the medial line to the lateral margin. The highly retractile head remains withdrawn and hidden from view when the larva is inactive, but when it is moving about, the glistening, mobile head is completely exposed. The caterpillar cuts off the anthers of the koa flower head to get down to the ovary and calyx, which it devours.

The caterpillar has no eversible dorsal abdominal glands. The absence of the abdominal glands found in some lycaenid caterpillars and their well-known relationships with the feeding of ants is an interesting feature. There are no endemic ants in Hawaii, and perhaps for this reason the caterpillars of this butterfly have lost the glands. Other lycaenid larvae elsewhere lack such glands, however, and the absence of glands in this species may not be significant. (See Hinton, 1951, on *myrmecophilus* Lycaenidae.)

When ready to pupate, the caterpillar spins a thin film of silk on the substratum and loops a thread of silk over it to hold it in place on the silk mat. The specimens I reared in February and March were in the pupal period from eight to ten days.

Tuely (1878:10), who stated that the type series was taken "in a mountain pass in the Island of Oahu in March," quotes the following notes from Blackburn: "flying about in some numbers, frequenting the flowers of the Koa. . . . The insects were very tame, and when settled low enough, could be taken by the fingers, the majority, however, kept high up beyond the reach of any ordinary net."

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